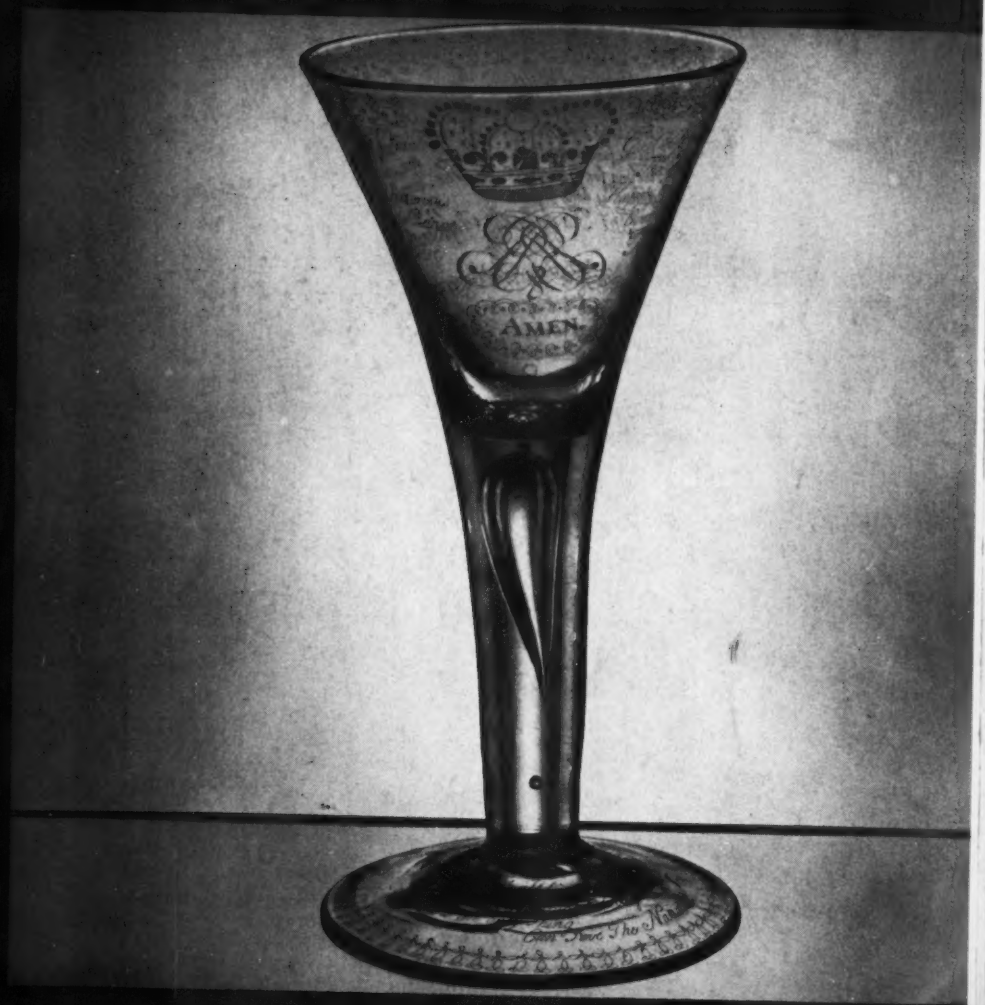
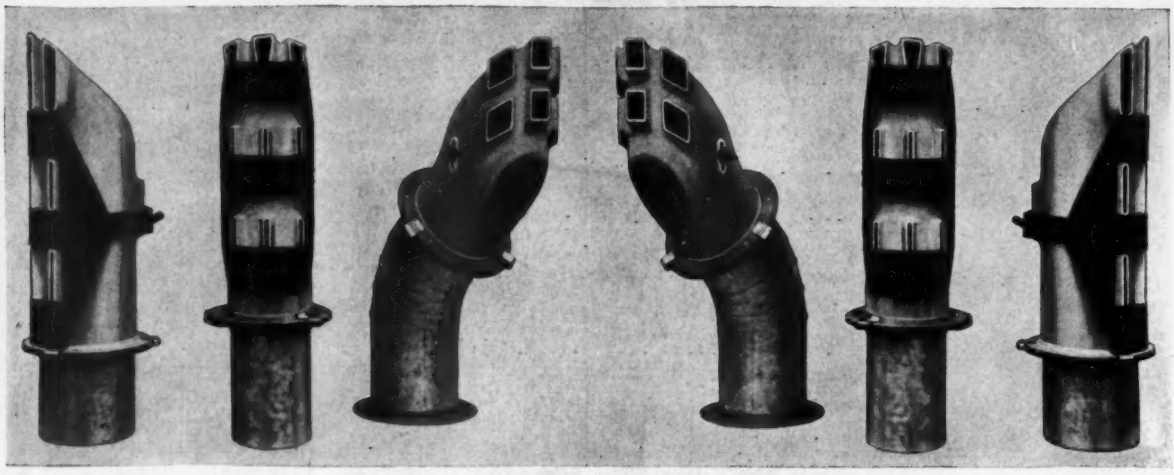
the glass industry



New K & B NOZZLES *with* ORIFICE AREA CONTROL

(Patent Applied For)



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IN MODERN glass plant practice, relatively little cooling air is required during the early life of the furnace, or in cold weather; but, as time goes on, and the blocks wear thinner, more and more air is needed. Two or more supply fans, operating in parallel, will provide adequate volumetric flexibility and give proper insurance against mechanical failure.

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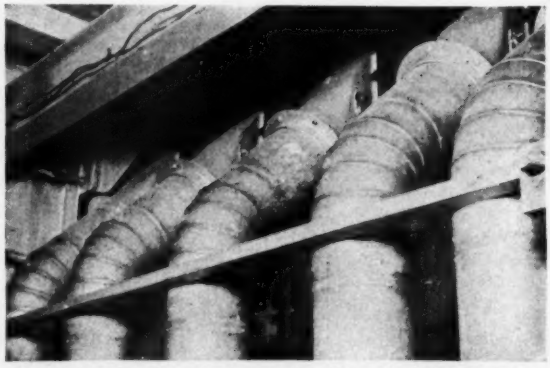

Kirk & Blum Cooling System entering side wall of furnace under port at Brockway Glass Plant, Brockway, Penna. Note the New K & B Cast Nozzles, equipped with regulating dampers to control volume of cooling air.

Complete details will be sent upon request • Send for book—"Cooling Systems for the Glass Industry"

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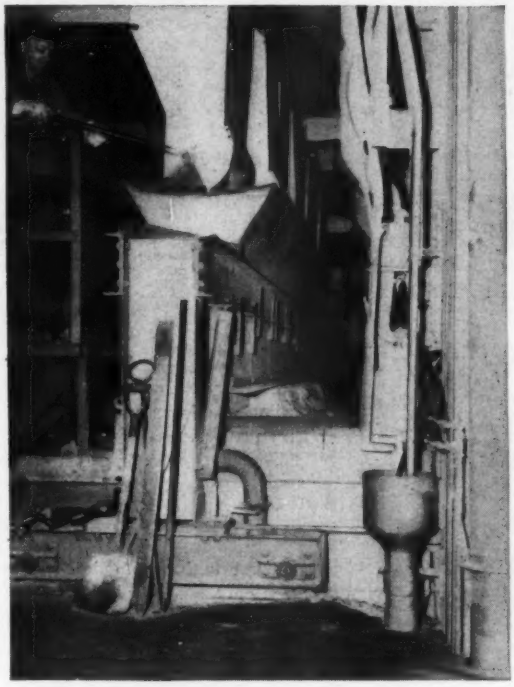

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the glass industry

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"Further advantages are that we can raise the temperature to the melting point without marking the ware."

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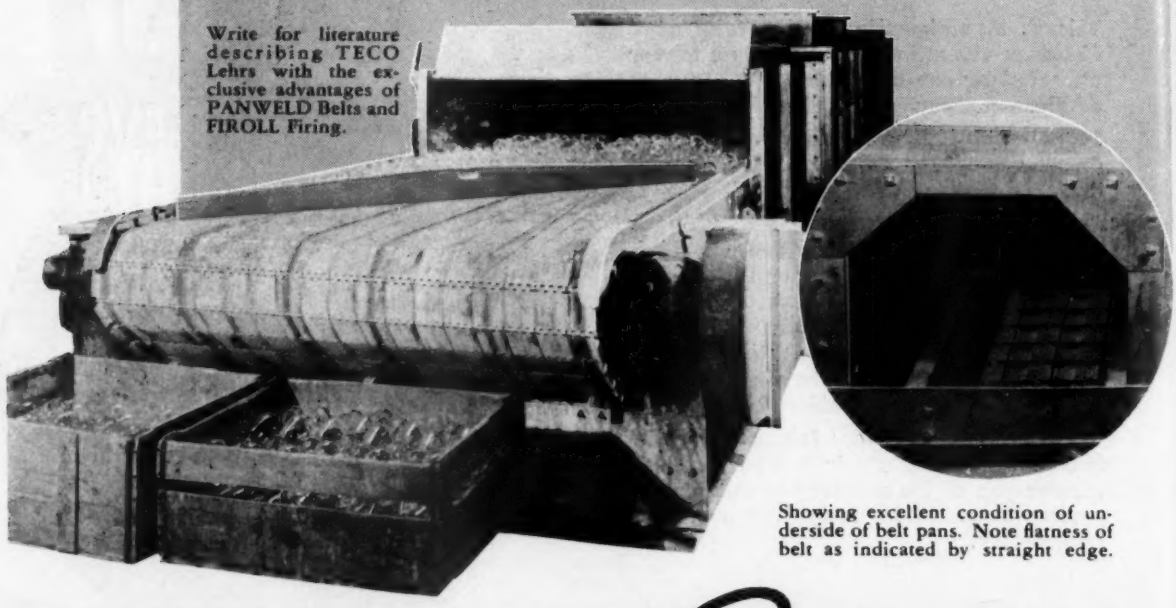

Showing excellent condition of underside of belt pans. Note flatness of belt as indicated by straight edge.

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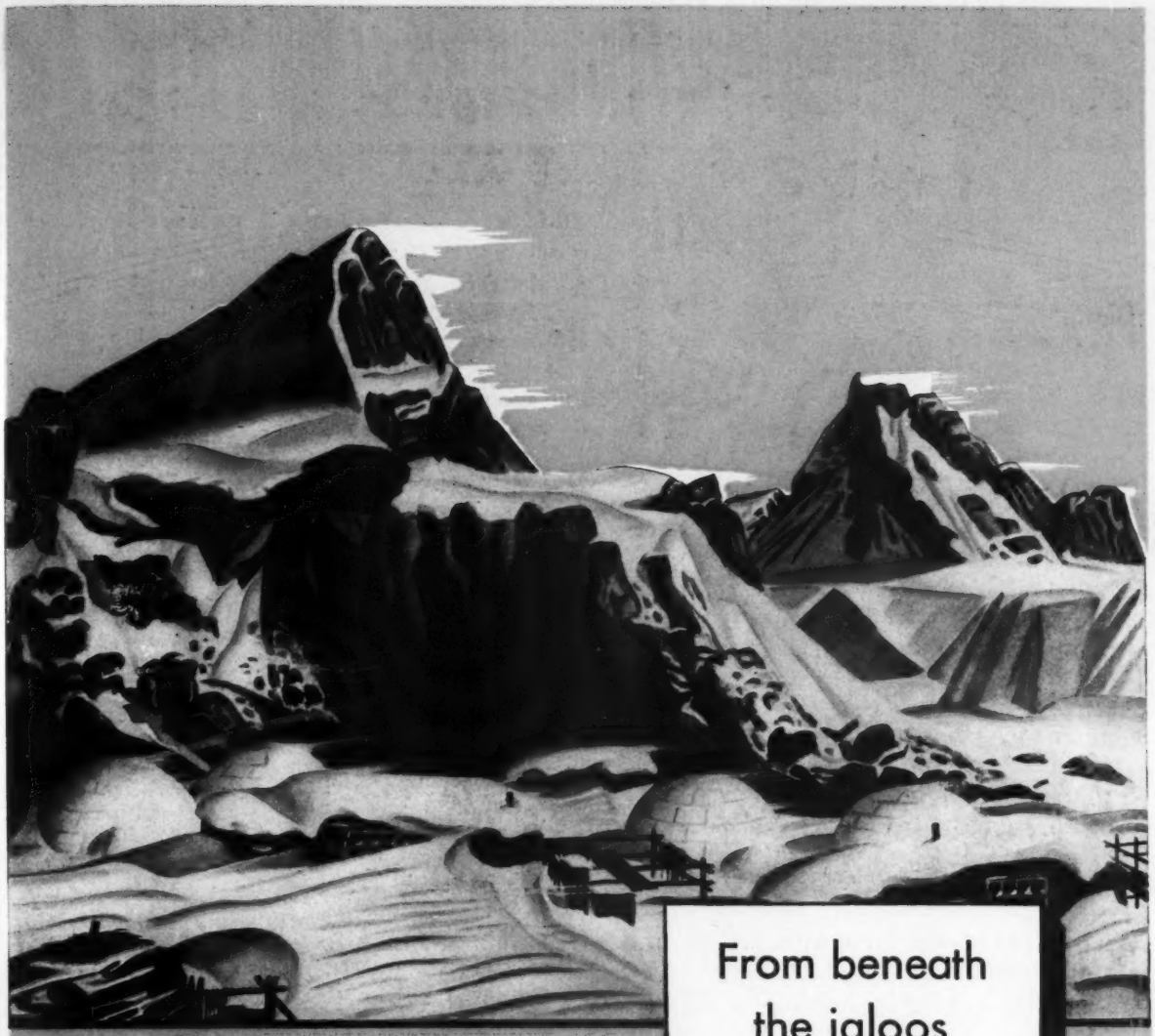

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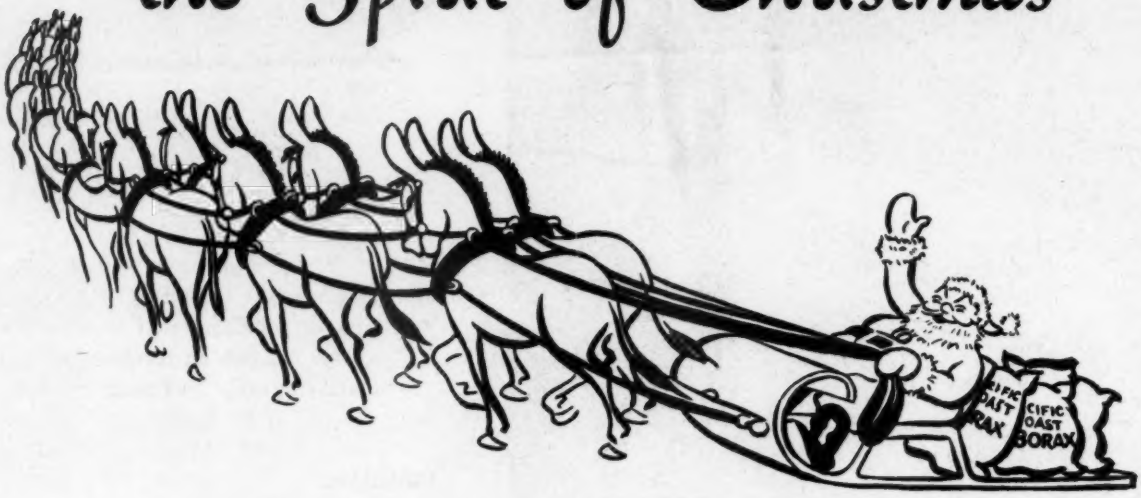
Chemicals

Pulling for the Spirit of Christmas



• At every season of the year the Pacific Coast Borax Company is pulling for industry. But at this particular season we are pulling especially for the Spirit of Christmas. And so, instead of giving our usual analogy this month, and the reasons why Borax is an important ingredient in the glass batch, we want to take this opportunity to wish the glass industry the season's greetings — a very Merry Christmas and a Happy, Prosperous New Year.

29

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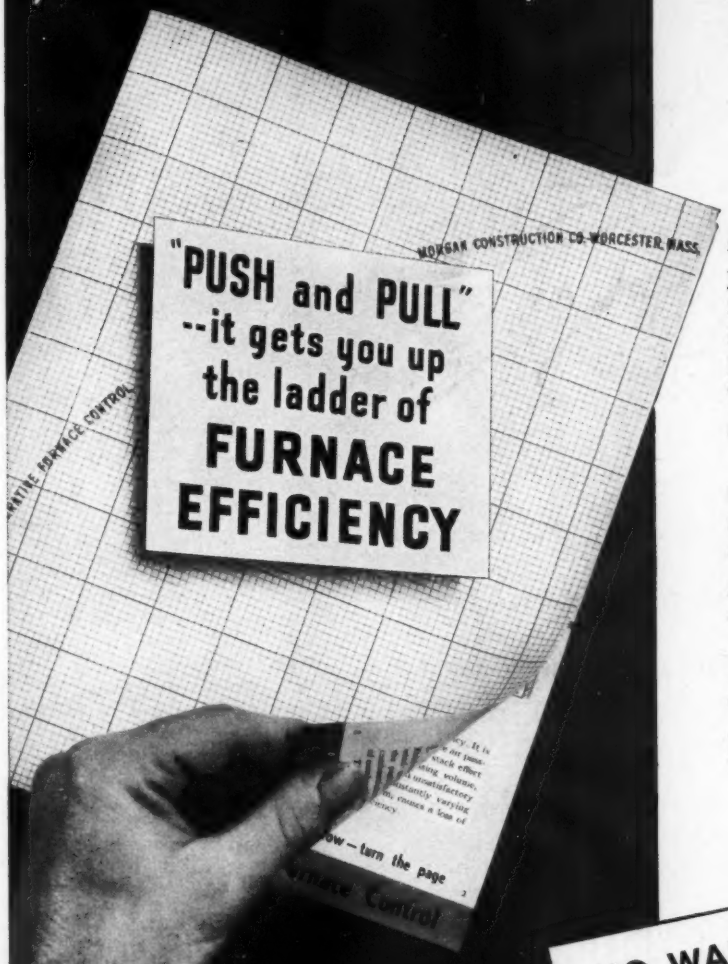

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BACK in 1936, the used working-end bottom of the above furnace was paved with Corhart Standard Electrocast. In 1937 the entire melting-end bottom was also paved throughout with Corhart.

This photograph, taken during the first (and only) repaving since then, shows several rather interesting points:

(1) The old Corhart Electrocast paving in the melting end protected the lower clay bottom and was removed without damage to other parts of the unit.

(2) The new Corhart Electrocast paving is composed of odds and ends varying in size and thickness — whatever Corhart blocks were available at the time.

(3) The new Corhart Electrocast paving is being laid on a bed of specially prepared Corhart Grain.

(4) The old Corhart Electrocast bottom in the refining end (not shown) paved in 1936, is not expected to be renewed for many more years to come.

In the case of Corhart bottoms, as with every other unusual application, the Corhart Refractories Company will not suggest the use of its products until proven by many successful installations. But we do feel that throughout the glass industry, enterprising operators will find food for thought in this "progress report".

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THE GLASS INDUSTRY

VOLUME 22, NUMBER 12, DECEMBER, 1941

URBANA CONFERENCE ON GLASS PROBLEMS

The seventh Conference on Glass Problems was held at the University of Illinois on November 14 and 15 and was devoted to the practical problems of glass manufacture.

The Seventh Conference on Glass Problems under the auspices of the Department of Ceramics at the University of Illinois opened on November 14 with 75 enthusiastic plant executives, operators and engineers in attendance. This gathering, which is devoted to the discussion of matters of particular interest to production men, was again characterized by the presentation of definitely practical papers and discussions. As hitherto, the Chicago Section of the American Ceramic Society cooperated in planning for the meeting and G. G. Hanson of Chicago assisted Professor C. W. Parmelee and his staff in making the arrangements and in providing for the entertainment of the visitors. A fine spirit of cooperation and frank exchange of ideas was in evidence, not only in the formal sessions, but in the friendly gatherings in small groups for informal conversations, for which ample opportunity was presented. Dean M. L. Enger welcomed the group at the opening of the Conference. He exhibited pardonable pride in the work which has been done on glass at Illinois and his greeting was thoroughly cordial, if brief, as he made way for the serious matters which formed the main purpose of the gathering.

Personally conducted tours of the various laboratories in the building devoted to ceramics, especially in the rooms where researches by graduate students on glass are in progress, were of great interest to the visitors. Dr. A. E. Badger, who is in direct charge of the glass research, gave a summary of the work now in progress and researches accomplished since the previous meeting of this group at Urbana. One of the most interesting of the problems deals with the question of the transfer of heat through molten glass. In the course of this work it has been shown that when a large crucible of glass is heated from the surface the temperature indicated by a thermocouple immersed in the glass is actually higher when the glass contains ten times the normal content of iron oxide; that is, if iron oxide is added to a melt so as to bring the content from 0.03 to 0.3 per cent, the diathermanency is actually increased.

Among other matters being studied, Dr. Badger mentioned the fluorescence of glasses containing certain coloring oxides, the power factor in comparison with dielectric strength of glasses at high frequencies, the electrical conductivity of glasses, and the fading of colors under ultra-violet light and under x-rays. Glasses containing fluorescent materials were studied, and the best sizes for enamel frit and colored particles were determined.

Melting characteristics, as affected by zirconia, titania,

Conferees at the Seventh Conference on Glass Problems, held at Urbana, Illinois, last month.

and calcium fluoride in the glass and also the attack of molten glass upon various metals, were subjects of further researches.

Durability was investigated from the standpoint of the effect of salt vapors on glass surfaces. The persistence of cords in relation to the property of surface tension was another interesting subject experimentally handled.

Dr. Badger also mentioned, in addition to the completed projects already named, work on the structure of glass, its spectral transmission in the molten state, volatilization of fluorine from opal glass melts, the expansibility of iron-bearing glasses, and continued researches on electrical conductivity and solarization. The Chemistry Department at Illinois now has an electron microscope, with which it may be possible to photograph the colloidal particles in glasses such as ruby.

Dr. W. B. Silverman, Owens-Illinois Glass Co., reported work on cords in glass, using a technique familiar to those who had heard his paper given before the Glass Division. By laying fibers of foreign glass upon the surface of a melt and observing the rate at which the fiber spreads and incorporates with the main body of the glass, he could correlate the effect with measured values for surface tension. When the glass of the fiber has a greater surface tension than that of the main body of glass, it persists as a cord. If the glass of the melt has the higher surface tension, it seems able to pull the fiber apart and cause it to spread, at least over the surface, so as to lose its identity as a cord.

In view of the tendency of alumina to increase surface tension, in contrast with silica, Dr. Silverman disagrees with some recent findings as to siliceous cords. However, in the ensuing discussion, the existence of siliceous cords was stated as a demonstrated fact.

D. W. Ross, Kirkwood, Mo., gave an enlightening summary of the sources of stones in glass. Drawing upon his experience in the production of glasshouse refractories and his observations on their use and abuse, he was able to trace certain stones to defects in block manufacture, and others to the careless operation of tank furnaces. Stones arising from batch and from devitrification were also discussed. In connection with covered pots, Mr. Ross made the interesting point that the stopper, which is necessarily of more open structure and therefore not highly resistant to the attack of fluxes, is probably a prolific source of stones. His talk was well illustrated by blackboard sketches and diagrams.

The "Progress Report on Research on Glass Molds", by W. H. Bruckner, Department of Mining and Metallurgy, University of Illinois, indicated that the intensive studies of cast irons now under way may go far toward solving the problem of more durable molds for mechanical production of glassware. The simple chilling process, although it yields a fineness of grain that makes for excellent surface polish, must evidently be followed by carefully prescribed heat treatment, if strength adequate to resist temperature changes and consequent cracking is to be developed.

Mr. F. W. Dixon, Jr., of Gunite Foundries Corporation, contributed an excellent discussion of the foregoing paper. He pointed out that a more frank exchange of ideas between operator and moldmaker will be necessary, that full history and behavior of castings may be correlated with attempts of the foundry to provide better metal.

On Friday evening, the group enjoyed an excellent dinner together in one of the dining rooms of the magnificent new Illini Union, a building provivded largely by alumni donations to be the center of the social life of the University, and beautifully suited to this purpose.

The after-dinner speaker was Dr. Crist of the Department of Geography, whose journeys in Venezuela as an oil geologist have made him familiar with its topography and its people. He showed a series of excellent photographs in color, showing the home life and the agriculture of the Venezuelans, and the rugged beauty of their mountains and valleys. His comments and descriptions were highly original.

Saturday morning's program opened with a paper by Dr. J. E. Ablard, B. F. Drakenfeld and Co., who showed by actual microscope projection, by slides, and by verbal description, the strain relationships between glass and its fired-on decorative enamels. The main idea developed was, that the "ceramic color", while it need not completely fit the glass as to expansibility, should have slightly less total contraction on cooling than this glass. It thus develops a small compressive strain. If the enamel contracts more than the glass upon cooling, it is thrown into tension and is tender when thermal shock is applied. The matter of solution of certain constituents of the enamel by the glass, mainly alkalis, was treated at some length. This elaborate study is one of the most complete presentations of this important subject yet made, and its complete publication may be awaited with interest.

Following the taking of the official photograph of the gathering, on the steps of the Ceramic Building, the program was resumed, with a talk by Dr. S. R. Scholes, N. Y. State College of Ceramics. He spoke on "Some Aspects of Modern Furnace Design and Operation", stressing the fact that the glass tank has been materially improved in detail, although its form and principal features have remained essentially the same for a half-century. Operators of glass tank furnaces, he said, ought to take full advantage of demonstrated improvements in flame control, in the use of automatic equipment, mechanical charging, and new knowledge concerning the real movements of the glass. Referring in particular to the radical proposal of Zotos for melting glass in a rapidly-revolving cylindrical furnace, he suggested that such a proposal ought to be examined carefully for its practical possibilities, and not be rejected off-hand.

A discourse on one of the recent, but apparently well-demonstrated, improvements in furnace operation was next presented by C. T. Frazier, Frazier-Simplex, Inc. The charging method described involves the mechanical introduction of batch in a continuous "blanket" nearly as wide as the tank, beneath a suspended back-wall of adjustable height. The advantages claimed are constancy of flow, great reduction of doghouse-block corrosion as well as lessening of side-wall attack, elimination of dusting and consequent minimizing of checker clogging and slagging, and reduction in fuel consumption, with general lowering of furnace temperatures, as a result of better presentation of raw batch to the melting action of the flame and of the hot glass beneath. Slides showed the new construction, also pictures of actual installation, and Mr. Frazier was able to give interesting figures on the results of actual operation of the device.

While the present high state of activity in glass manufacture probably kept many from attending, the conference represented a fair cross-section of the industry. The registration list disclosed that men working in nearly all branches of glassmaking, from factories large and small, had enjoyed another of the events from which the Illinois department has an established reputation.

Recent Research on Glass in Department of Ceramic Engineering. *By C. W. Parmelee and A. E. Badger, University of Illinois.*

These Glass Conferences are primarily for discussion of glass factory problems, and since much of the work in which our laboratories are engaged does not have direct practical application, the subjects on which work has been completed since the time of the last conference will be mentioned only very briefly. This work has been carried out by various members of the staff and by advanced students. The work published since the last conference may be divided in various groups.

First, concerning the electrical properties of glass, two papers appeared, one dealing with the dielectric loss of glass at high frequencies and the other with the electrical conductivity of glass. The change in these properties which occurs when equivalent additions of various oxides are incorporated in a parent soda-lime-silica glass.

Concerning colored glasses, three articles were completed, dealing with gold ruby glass, with vanadium-bearing glass, and with the color changes which occur in glass after long exposure to light. This last effect, usually called fading or solarization, was studied using a spectrophotometer recently installed in the Electrical Engineering Department. By means of this apparatus, a record of the spectral transmission or reflectance of glass or other material may be obtained within a few minutes.

Other colored glasses containing fluorescent materials were studied, the fluorescent spectrum being obtained at temperatures varying from that of liquid air to the temperature where fluorescence stops. In connection with some work on colored stains used for vitreous enamels, the optimum sizes of enamel frit and colored particles were determined. In many cases it is found that the results of work with vitreous enamels can be applied to glass technology, and vice versa.

Dealing with the chemical composition of glass, some of the melting characteristics contributed to glass by the presence of zirconia, titania, and calcium fluoride were determined. In another series of experiments the reactions were observed which take place between various metals and molten glass.

Work having some possibility of commercial application dealt with the subjects of chemical durability of glass as affected by the vapors of various salts, the persistence of cords in relation to the property of surface tension, and the penetration of heat through various molten glasses. The last-named topic illustrates the great difference between laboratory and factory scale tests. The experimental set-up consisted of a method of measuring the temperature in molten glass at various depths, the melting pot containing about 40 lbs. of glass. Although these results can have only limited application to a large commercial tank, the method can be used to study heat penetration through various glasses. In many instances the disadvantages of laboratory experiments, which are the result of the small scale of the experiments, are compensated by the closer control of conditions as compared with factory tests.

So much for work completed since the last Conference. Work now under way deals with the structure of glass, the spectral transmission of molten glasses, the volatilization of fluorine from opal glass melts, and the coefficient of expansion of iron-bearing glasses, while the previously-mentioned topics of electrical conductivity and solarization are being continued. Also, a study of the size and shape of colloidal particles in various glasses, such as the rubies, is to be made with an electron microscope recently installed in the Chemistry Department. It is hoped that these particles may be made visible under the magnification 30,000 diameters which is possible with this instrument.

Recent Work on Cords. *By W. B. Silverman, Owens-Illinois Glass Co.*

Only in exceptional instances are commercial bottles entirely cord-free. The most dangerous cords arise from large errors in batch preparation or from the stagnant glass that enters the active glass stream following increased loads on the tank. An appreciable percentage of extremely cordy ware is eliminated by spontaneous breakage in the lehr or shortly after packing.

Experiments were described in which cords were formed by melting glass fibers of known composition .06 inch in diameter with a homegeneous glass blank in platinum at 1250° C. The fiber constitutes about .7 per cent of the mass. The surface tension of all of the glasses was determined by the dipping cylinder method. The data showed that if the surface tension of the glass fiber is higher than that of the matrix a cord persists over a long interval of time. When the glass fiber is of lower surface tension than the matrix, no evidence of cord can be found.

The examination for cords was made in both parallel and polarized light. Viscosity apparently is only a minor factor in the dispersion of cords. Glasses of low viscosity and high surface tension behave similarly to glasses of high surface tension and low viscosity. It was shown that by adding .5 per cent V_2O_5 to a high surface tension glass containing 8 per cent alumina no cord would be present at the end of 10 minutes at 1250° C.

Reference was made to the work of Badger and Pinnow on the addition of oxides, such as oxides of vanadium, cobalt and chromium, to pot clay. These results indicated that finer and less persistent cords formed when the glasses in contact with vanadium or chromium containing refractories than when the glass is in contact with a refractory containing cobalt.

The effect on cord formation of differences in density at 2600° F. was shown by means of photographs. The studies were made by melting and fining homogeneous glass in a sillimanite crucible. The crucible was then removed from the furnace and a second glass was introduced on top of the original glass. The crucible was then returned to the furnace and kept at 2600° for 3 hours. The crucible was then removed, placed in an annealing oven and brought to room temperature. A vertical section was then cut through the crucible and examined in parallel and in polarized light.

When a light silica glass is placed over a denser soda-lime glass, it is found that the line of demarkation is sharp and no cords are formed; the only stress present is due to the high difference in co-efficient of expansion of the two glasses along the line of demarkation between the two compositions. When the position of the above glasses is reversed, a very highly strained section is obtained but examination in parallel light reveals very indistinct boundaries between the different areas in the section.

When a dense high alumina glass is placed over a less dense soda-lime glass, an extremely cordy section is formed and the glassses of different composition show very distinct lines of demarkation.

Some results on thermal shock tests were described wherein the maximum difference in expansion between the cord and the homogeneous section could be no greater than -12×10^{-7} without spontaneous fracture. The thermal shock differential of similarly shaped specimens is not affected until the difference of -7×10^{-7} is reached. Between —7 and —12 $\times 10^{-7}$ the temperature differential was lowered. When the cords had a positive difference (when the cord is in tension), less definite results were obtained but there was some indication that the thermal shock differential was not affected but spontaneous fracture of the speciman occurred definitely when the difference in expansion reached $+ 14 \times 10^{-7}$, Compressive fractures ran parallel to the cords. Spontaneous tension failures were at right angles to the cord.

In the heat shock tests the compression cords failed so as to involve the cord itself. In the specimen in which the cords were under tension the cord was not necessarily involved in the failure.

Sources of Stones in Glass. *By Donald W. Ross.*

Vitrification in service of walls for use against molten glass is first reviewed as a background for consideration of the sources of stones in glass.

Next stones from raw batch are described as arising from adventitious materials that find their way into the batch and from impurities in the batch materials themselves.

Melting stones are described as arising from unmelted sand scum and from devitrification products from made glass.

Stones from the refractories are described as arising both above the metal line and below it. Those from above the metal line are described as sodium-silicate or nephetite slag laden with undissolved fragments of refractory and/or with a devitrification product in the form of secondary corundum. Those from below the metal line are described as arising largely from broken or defective blocks.

Some Aspects of Modern Furnace Design and Operation. *By S. R. Scholes, New York State College of Ceramics.*

The glass tank, in the half-century since its general adoption as a melting unit, has undergone no really radical changes. Certain minor changes and improvements in operation have been made, such as: the development of luminous-flame firing; mechanical charging; automatic control of temperature and draft, and automatic reversal of valves at temperature rather than time intervals; the suspended (flat) crown; better post construction and checker stacking. Recent knowledge, particularly as to the character and significance of convection currents, is especially significant and important. The users of tanks should become acquainted with the best that has been done or learned about them, and not be content to use older designs or older methods. The question may well be raised, is the present continuous tank of the bridge-wall type essentially the final form of glass-melting unit, or, can we look to some fairly radical proposal, like that of Zotos, as forecasting the tank of the future?

Report of Progress in the Metallurgical Study of Cast Iron for Glass Molds. *By W. H. Bruckner and H. Czyzewski, University of Illinois.*

A number of cast irons were tested in the metallurgy laboratory of the Department of Mining & Metallurgical Engineering University of Illinois for their susceptibility to cracking by means of an accelerated test which would indicate the service behavior of the cast iron when in the form of a glass mold and in use on a glass-forming machine. The chemical composition of the cast irons represented plain irons and alloy irons. The alloy irons were tested in the chill cast condition and in the sand cast condition. The chill casting is the usual condition of glass-forming molds where the working face in contact with hot glass is chill cast in order to obtain a highly polished metal surface. All of the irons, plain, alloy, chill and sand cast were subjected to a number of heat treatments to determine the effect of modifying the microstructure on the susceptibility to cracking. The path of the cracks resulting from the accelerated test was examined to determine the effect of macro- and microstructure of the cast iron on the progress of the cracks. A number of actual glass molds which had failed at a low grossage were examined in an attempt to determine the cause of the short service life of the molds. The sand cast irons were found to be the most resistant to cracking during the accelerated cracking test. It appears that the sand cast iron would give superior service as a glass-forming mold if it were possible to produce a smooth, highly polished surface. It is however not possible to produce the necessary, high polish on this type of iron therefore it is unsuited for use as a glass mold in spite of its excellent resistance to cracking. The chill-cast alloy irons were found to have a superior resistance to cracking compared with the chill-cast plain irons. The alloy iron with additions of nickel, chromium and molybdenum had by far the greater resistance to cracking and approached the sand cast irons in this respect.

The behavior of heat treated specimens in the cracking test indicates that annealing the chill cast iron increases its resistance to cracking but if the pearlite is in the spheroidized condition the iron has a lower resistance to cracking then when in the "as cast" condition. Proper heat treatment of the chill castings for glass molds therefore appears to be essential to attain optimum service behavior. The cause of the early failure of the glass molds examined was attributed to the heat treatment which they received. The heat treatment had spheroidized the pearlite and formed a ferrite matrix of low strength.

"AMEN" GLASS TO MUSEUM

One of the rarest specimens in the world of antique English glass has been presented to the Metropolitan Museum in New York by Arthur A. Houghton, Jr. It is a Jacobite "Amen" glass made in England about 1749.

The "Amen" glass is a simple trumpet shaped design standing seven inches high and three and a half inches in diameter. It has a drawn stem and foot elaborated with a tear drop. The bowl and foot have been decorated with fine diamond point engraving; the bowl carries the Royal Cipher and Crown, and the word "Amen" (meaning "So Be It" in fulfillment of the restoration cause). On the opposite side it bears the inscription "To His Royal Highness The Duke and The Increase of The Royal Familie") with three verses of the Jacobite National Anthem within scrolled borders. The fourth verse is engraved on the foot.

It is generally believed that there are only five or six "Amen" glasses in the world today, and on two, such as this, bearing all four verses of the anthem. This one was a family specimen belonging to Mrs. Palmer Douglas of Hawick, Scotland. It is valued at two thousand dollars. It is the first "Amen" glass to come on the market, as far as is known, in America. It was sent to this country in August by Cecil Davis, renowned antiquarian of English and Irish glass, who has been assembling the antique collection for Steuben Glass, Inc., New York.

These "Amen" glasses have a curious history. During the early 18th century they were used as drinking vessels or toasting glasses by the followers of the Stuart Cause in England and Scotland. Following the Revolution of 1688, William and Mary came to England, and the Stuart pretender to the throne went into exile. For nearly a century, however, the Stuart loyalists, the so-called Jacobites, maintained their allegiance, meeting in secret and forever plotting for the return of the Stuarts. The "Amen" glasses played an important role at these meetings as they were inscribed with the Jacobite anthem from which the present "God Save the King" is derived.

WILLIAM J. BELKNAP

William J. Belknap, nationally known patent attorney who was one of the counsel for the Hartford-Empire Co. in the glass trial in Toledo's Federal Court, was found dead November 19 in his apartment in Toledo. Mr. Balknap, aged 58, was a brother of Charles B. Belknap, vice chairman of the board of directors of the Owens-Illinois Glass Company. He was a member of the firm of Whittemore and Belknap, Detroit.

• General Electric stockholders on November 20, record date for paying the December 20 dividend, totalled 218,434, an increase of 5,594 over a year ago.

THE TOLEDO TRIAL

Proceedings in the trial of the anti-trust action against principal glassware manufacturers in Federal Court in Toledo, O., moved so slowly during the first month of the defense testimony that any possibility of finishing the case before spring had disappeared. Until recently Judge Frank L. Kloeb had hoped to complete the taking of testimony before the Christmas holidays. There is a possibility that, since this possibility has faded, the press of other matters on the court docket may enforce a prolonged recess in the glass case.

Defense testimony has been offered to date principally through the two key figures in the history of the Hartford-Empire Co., Karl E. Peiler, engineer and inventor, and Vernon M. Dorsey, eminent patent attorney.

Near the end of the testimony of Mr. Dorsey a new situation presented itself to occupy the time of the attorneys for two of the defendants. The Hazel-Atlas Glass Co. filed a motion in the U. S. Circuit Court of Appeals in Philadelphia asking that the old patent suit between it and the Hartford-Empire Co., settled by agreement in 1932, be reopened. Hazel-Atlas cited newly discovered evidence as grounds for the request. The controversy centers about the validity of prime patents in the gob feeding field. It was presumed that evidence introduced by the government during the present case had supplied Hazel-Atlas with the new information.

It was regarding the controversy between these two firms that the government charges with reference to the now famous "Clarke article" applied. The government charges that an article published in a trade journal over the signature of William P. Clarke, former president of a glass workers union, actually was prepared by the Hartford-Empire Co. for the purpose of influencing the U. S. Patent Office in the then pending case. That was in 1926.

The litigation went on through the patent office, the U. S. district court, and finally was appealed to the U. S. Circuit Court. The appeal, however, was dropped in 1932 by a settlement contract between Hartford and Hazel.

This contract, which has been the subject of a bulk of the testimony in the trial so far, has been attacked by the government as being illegal. It is this contract, also, which was involved in the court order issued last June requiring that all exchange of funds between the two companies must be deposited with the clerk of Federal Court in Toledo pending the completion of the anti-trust action. This sum will run into several million dollars, it has been estimated.

The involved tangle became even more intricate when court was resumed here in October when Hazel-Atlas and Hartford-Empire announced that the question of validity of certain patents involved in the cross licensing made the amounts due the respective firms a matter of controversy. An arbitrator is at work on the question of the patent validity now.

Under the contract Hazel-Atlas must pay a royalty to Hartford-Empire on the use of certain patents and Hazel-Atlas receives a one-third share of Hartford's divisible income.

The testimony of Mr. Peiler constitutes an interesting and graphic story of the development of the glassware industry from the days of the old hand-gatherer blowpipe methods. Mr. Peiler is recognized as one of the leading engineers in the glass machinery world.

Mr. Peiler's ability to give explanations of technical works and processes clearly and precisely amazed the courtroom attaches. The record of his testimony is filled with gems of clear English which make the functions of intricate machinery easy to understand.

Many of the seemingly irrational quotations taken from files and offered without complete pictures were made to appear logical and reasonable with Mr. Peiler's explanations. He admitted frankly the purpose of some patent applications was to "block in" or protect the primary patents from being copied or infringed. He gave a reasonable account of instances where this had been done and where it had proved necessary.

The dealings between the Hartford-Empire Co. and the Owens interests of Toledo prior to the agreement of 1924 were covered again, the defense offering facts to complete the picture which had been placed before the court by the government.

One letter was introduced bearing on the colorful personality of the late Michael J. Owens, famous inventor of the suction process for making glassware. The letter, written by F. Goodwin Smith to one of his associates, told of Mr. Owens having attacked the Hartford-Empire interests in a virtual verbal barrage. All this was part of the negotiations, which culminated in a cross licensing agreement between the two firms in 1924.

Somewhat of a setback, although not a serious one, was handed to the defense when the Hartford-Empire attorneys called Arthur E. Van Bibber, a business consultant from Pasadena, Calif., to the witness stand.

Mr. Van Bibber was identified with the Diamond Glass Co. The defense sought to show through his testimony that the Hartford-Empire Co. proved beneficial to that concern when it was in a bad way, sending engineers and service men who were instrumental in placing it back in a position where it could compete successfully with the remainder of the industry.

It was the contention of the defense that in this way that the Hartford-Empire Co. thus actually fostered competition rather than, as the government charges, destroyed it.

The youngest lawyer in the courtroom, James Carlisle, spoke for Hartford-Empire on this issue and presented one of the ablest arguments from a legal standpoint which yet have been heard in the case. Despite Mr. Carlisle's able effort, however, Judge Kloeb held that the evidence which the defendant thus sought to introduce was not proper at this particular juncture.

The testimony of Mr. Dorsey was long and involved, covering the legal aspects of many of the things dealt with in a practical manner by Mr. Peiler. Mr. Dorsey, a director of Hartford-Empire for many years, is one of the outstanding patent attorneys of the country. He participated in most of the litigation and the negotiations which Hartford had with other interests in the glassware industry.

(*Continued on page* 541)

NEW PROCESS FOR GLASS AS ART MEDIUM

By THEODORE LAYMON

The increasing use of glass as an important medium of modern artistic expression received further recognition in October when New York art critics praised the work of Joep Nicolas, Dutch artist, who was given his first representative exhibition in the United States at the Orrefors Galleries. A descendant of several generations of glass masters, Nicolas came to this country in December, 1939, after having established a reputation abroad as a leader in the art of glass decoration, both as artist and technician.

Nicolas, who is forty-four years old, a native of Roermond, Holland, said that when he acquired new artistic conceptions in keeping with modern trends, he found it almost mandatory to find new technical processes to go with them. His most essential departure from the old ways of adapting technical methods to glass work came in 1931, when he turned to making glass murals in a new manner based upon the use of flashed opaque glass with a fired-in pattern and partially etched away backgrounds.

He has patented this method in Holland, Belgium, France and Germany and has similar patents pending in the United States. He believes he is the only person in this country using the process.

The idea for this technique came from his admiration for the durability and highly artistic effect of glass mosaics like those made in the Byzantine and early Romanesque periods and also out of consideration that this mosaic technique never could answer the needs of a modern artist, who, he said, "expresses his spiritual tension more in a free handwriting than in a staccato-rhythm of little pieces of glass reassembled in a pattern."

So Nicolas combined the advantages of the durability of the glass materials with the modern possibility of individualistic designing by adapting the old firing techniques applied to the making of stained glass windows to this new material of flashed opaque glass. This glass became useful and necessary, he said, through development of modern artificial lighting techniques and proved to be an excellent basis for glass painting not meant as translucent but decorative light reflecting panels.

A glass window in the Museum of Fine Arts, Brussels.

The difficulty was to find the exactly corresponding colors. As Nicolas explained, "It was obvious that glass enamels were not desirable because we knew the 13th Century stained glass windows were frequently treated with enamel paints with the disastrous result that the colors chipped off, due to the different degrees of extension in temperature changes.

"The only colors left were the so-called 'Grisailles,' These 'Grisailles,' whose name is derived from monochrome or gray painting, are chiefly composed of metal oxides with the addition of flux to help the melting into the surface of the glass. They range from stone-red to olive green, with all the nuances in between, but always will stay in a rather subdued gamut of colors, and have the great advantage of absolute durability and immunity to atmospheric influences."

In combination to the firing in of patterns with these "Grisailles" colors, Nicolas found in 1931 that the treatment of backgrounds with liquid silver and gold gave a very artistic effect, but to have the silver and gold well-protected, these metals had to be fired in from the back. This required etching off the opaque sheet on the parts where the background had to emerge.

For large glass murals where the texture of the surface can be less refined, Nicolas found that it was advisable not to go into the complication of the etching, but to cut the flashed opaque glass on the contours of the figures and to use for the background so-called antique glass. Otherwise the etching off becomes very expensive and such expense can be checked when it is realized that large murals viewed at a distance do not need so much refinement as smaller ones.

The first time these new-type glass murals were shown in public was in 1932 at the Salon des Artistes Decorateurs in the Grand Palais, Paris. The next year these murals won the grand prize at the Triennale at Milan.

In this technique, Nicolas executed important jobs throughout Europe in the following years, including a large mural in glass in the Netherlands Pavilion at the 1935 World's Fair in Brussels, the Royal Chapel of Leopold III in the Abbey of Orval and the glass mural decoration of the first class dining salon of the Holland-America flagship "Nieuw Amsterdam," which is wholly artificially lighted. Some of his work is also in Holland House, Rockefeller Center, and he is presently engaged in carrying out several commissions here. Many of his finest works, among them the memorial windows presented by the people of the Netherlands to Queen Wilhelmina on the fortieth anniversary of her reign, are packed in cases and stored in concrete cellars, awaiting the end of the war.

Nicolas also adapted his technique to less extensive, but to the glass manufacturer, potentially more important commissions. These included glass murals for powder rooms, bars and grills, private homes and public buildings, one of which is the City Hall of Heerlen, Holland.

Nicolas was regarded as the fastest glass painter in Europe. He first makes a small scale sketch of the window or mural in full colors and then draws a full-sized design on paper, with thin brush lines correspond-

ing to the tracings which have to be fired in later on the glass and with heavier lines corresponding to the leadings separating the glass pieces. The different colors of glass are indicated on the cartoon by initials or figures at the proper places.

After an assistant cuts the necessary pieces of glass, a tracer copies on the glass the lines marked in the design. He uses tracing black or tracing brown, which is a vitrifiable color composed of copper oxide and melting substantials and has to be mixed with an Arabic gum and vinegar so that it will not come off when afterwards the matting color is blended over it. The tracing and other details completed, all the pieces are attached to a glass plate by dropping liquid beeswax mixed with resin in between the joints of the pieces.

The matting color then is blended over the entire surface of all the glass pieces, covering entirely the tracing design and presenting an absolutely dark aspect. This matting color, as used by Nicolas, has no binding material, but is ground in distilled water and gives little resistance.

Now the artist begins the real glass painting. Working alone and with assured speed, he takes away, with soft dry brushes, the matting color from the places where the lights must give prominence to the figures. It is like negative painting. The whole design is brought out by gradually accentuating the lights and leaving the shadows, but the artist must be careful not to take away too much of the matting color, since as Nicolas explained, "It

"Wisdom." One of a series of twelve windows in the great auditorium of the State University at Utrecht.

Stained glass windows in a power plant in Maastricht, Holland.

is nearly impossible to get the same freshness in retouching the glass."

After the painting is finished, the painted pieces of glass are detached from the glass plate and frequently some yellow stain, composed chiefly of silver nitrate, is applied on the back of the pieces where a transparent yellow is required. Then follows the firing. Nicolas prefers the muffled type of kiln, which according to its size, takes from four to eight hours to fire the glass. Quicker firing, such as is done by the stretcher kiln, requiring only ten to fifteen minutes, he does not favor, having found that such quick firing makes the control of the right temperatures difficult. It also, Nicolas found, makes the cooling off process go very rapidly, and the heated glass, exposed too soon to the cold air, "might gather tensions which may eventually cause the glass to split." He said electric kilns, with automatic heat regulators, were practicable.

Nicolas formerly obtained his colored glass chiefly from English, French, German and Bohemian manufacturers, but he is now relying on American glass. His glass colors, which he also formerly bought abroad, are now his own preparations and products of two American firms. "The American colors and glass," Nicolas said, "require a little different way of treatment in application and firing from the European materials, but they are generally as good and certainly 100 per cent reliable." He did not reveal the secrets of his own color preparations.

When he got the idea for adapting the flashed opaque glass for mural decorations, Nicolas had to find out the specific reactions of this glass. In this he had the collaboration of a glass manufacturer in Czechoslovakia and another in Germany. In both countries, he said, they were making different types of flashed opaque glass for lighting purposes.

Nicolas has fifteen years of experience in doing stained glass windows, but he "got out of the routine of narrowly following the 13th Century tradition because there is no modern building where they can use the archaic twinkle of dark and rich colors which take away all daylight."

The fact that he received many commissions for stained glass work in business buildings, administration buildings, banks, hospitals, city halls, schools and homes, forced him to "find a way of doing stained glass windows in a light, gay, and unobtrusive character."

This, he said, "brought me to a free Arabasque sur-

rounded by white or slightly matted paints. The difficulty is to combine the movement of a free composition with the repeated and regular rhythm of simple white backgrounds. It urges an absolute abandon of stereotyped leadings, which result in every color spot being surrounded by a lead strip, causing a clogging together of heavy values not easily diverted into a light background. So means must be found to use the design of the leadings much more as a contrapuntal accompaniment of the design.

Nicolas believes there will be a much wider use for flashed glasses from which the color can be partially removed by acids than for the solid colors called pot metal glass.

He believes many churches would look better if they were not so "tightly closed with too-dark and too-would-be antique stained glass windows." At present, he is doing for the Presbyterian Church in Fairmount, near Cleveland, a series of thirty-six stained glass windows in which the compositions are "floating in a background of irregularly matted white glass."

This way of working, according to Nicolas, "needs much more the less obtrusive secondary but very refined colors than the heavy spectral blues, reds and yellows which are used in the traditional types of stained glass paintings." He expressed the opinion that American manufacturers who are producing the glasses should specialize in establishing a gamut of colors in flashed sheets as well as in pot metal to correspond to the needs of this modern tendency.

Nicolas, who is also a painter of note, is enthusiastic about all the new possibilities in the field of glass decoration, such as carving in glass, sand blasting and the art of glass grinding for decorative purposes, which if well publicized might open a larger field of adaptation in interior decoration. He is also enthusiastic about decoration on glass brick walls and on this technique he is collaborating with craftsmen of the Rambusch Decorating Company, which patented this material under the name of "Bloc de Cor."

It is in the Rambusch studios that Nicolas is now carrying out different commissions in stained glass painting and glass murals. Artistically he has found that "glass as a material for mural painting has a sufficient amount of evasiveness so as not to tell too much of a story, leaving something for the imagination. However, the possibility of every kind of figuration in glass exists, ranging from abstract allegory to dramatic composition of events without losing the strong and constructive character of real building material."

FTC HEARING IN WASHINGTON

In spite of the recent death of Trial Attorney W. C. Reeves, the Federal Trade Commission has scheduled an early hearing of its case Number 4450, against S. Buchsbaum & Company, Chicago, for misrepresentation in advertising that the company's products, under the trade name "Vinylite," are made of glass.

The case will be heard in the Commission's Washington offices beginning December 10, scheduled for three days. The trial attorney will be E. P. Schrup. A trial examiner remains to be named.

Although the Commission has cited a retailer, Saks and Company, New York, N. Y., for misrepresenting the qualities of Vinylite products in its advertising, the Saks case has been docketed under another number, 4619, and will not be heard at the same time as the Buchsbaum case. Saks sells Vinylite women's shoes which it calls "Glastique" shoes, calls them "Cinderella wonder-shoes . . . like glass with st-re-tch."

The case against Saks was filed October 27, and Saks was given two weeks to reply, but this period has been extended to December 2. It is probable that even though the Commission proves its case against the Buchsbaum company, it will have to proceed with a case against Saks. It is problematical, however, whether it would have to institute cases against other retailers, if it proves misrepresentation against Saks. Generally, in such actions, a case proven against one retailer is sufficient to cause others to cease similar practices.

GLASS AND POTTERY LECTURES

The Division of General Education of New York University will offer a course of fifteen lectures on "Glass and Pottery", beginning in February, 1942. It will be developed in collaboration with important industrial firms in these fields, under the direction of Professor Albert Charles Schweizer of the New York University School of Architecture and Allied Arts.

The subject matter will deal especially with the materials and methods of design, manufacture and marketing, and will particularly stress domestic practices and developments. The talks will be of a non-technical nature, addressed chiefly to designers, and the staffs of glass companies and retailers.

CORNING PROMOTIONS

Announcement of the appointment of Edward C. Leibig as manager of the Rhode Island Division of the Corning Glass Works, and Johnston B. Shimer as manager of the Wellsboro Division, was made at Corning Glass Works, November 21. Mr. Shimer who has been assistant production manager at the Rhode Island plant for the past two and one-half years, succeeds Mr. Leibig at Wellsboro. Mr. Leibig has been manager of Wellsboro since 1939.

• Mr. I. H. Taylor, vice president in charge of sales of Michigan Alkali Company, announced the appointments of Ransdell Matthews as assistant to vice president, Bert Cremers as director of sales, and J. H. Remick as manager of special products division at the November sales meeting of the company in Detroit.

• The 62nd annual meeting of The American Society of Mechanical Engineers will be held December 1 to 5 at the Hotel Astor, New York City. The important task of the engineer in the national defense program and some of the special problems being faced in the current emergency will be the keynote of the meeting. About 100 technical papers, many of them dealing with problems related to the war, will be presented and discussed during the meetings.

POSITION WANTED:—Graduate Engineer with nine years' experience, versed in furnace design and construction, desires connection with firm operating glass melting furnaces. Present connection with refractory company. Box 43, The Glass Industry, 11 W. 42nd St., New York, N. Y.

WATER HAMMER BREAKAGE IN GLASS CONTAINERS

PART III

By T. C. BAKER
Hartford-Empire Company

Summary of Previous Installments

Objective of Research—To discover the causes of one-tenth of a per cent field breakage in packed food jars. It was shown that water hammer breakage occurred when one carton fell upon another. Downward movement of the jars in the lower carton caused bubbles to form in the contents. When these bubbles collapsed, water hammer took place. This consists of two distinct phenomena: one is a general pressure that ranges from 25 to 250 lbs./sq. in. lasting 1/10,000 second, and the other is an intense local pressure of 50,000 to 500,000 lbs./sq. in. covering areas less than 1/10 of an inch in diameter and lasting only a few microseconds. The combination of these two phenomena with the ordinary defects in glass containers yielded nine different characteristic fracture patterns, which were described and illustrated.

The Factors Involved In Water Hammer Breakage

It is very difficult to give a complete picture of water hammer breakage, because there are a tremendous number of factors involved. Every new breakage complaint is one of hundreds of special cases. When factors such as weight of bottle and consistency of contents change, the effects of all the other factors are also changed. All factors seem to be interrelated. When a specific problem arises, there is little hope of using data obtained from other bottles or jars unless the new problem has approximately the same constants.

Some calculations were made on the amount of energy required to produce a pressure of 200 lbs./sq. in. on the bottom of a jar. In a bottle similar to a steinie beer of 12 oz. capacity and 10 oz. weight, we found that only 0.1 of a foot-pound of energy could be stored by both the glass and the water. Since experiments with the oscillograph had shown that the bottle would require nearly a hundred times that amount from an impact of energy to produce a pressure of 200 lbs./sq. in at the time of water hammer, it was obvious that tremendous losses of energy took place between the time of impact and the time of water hammer.

These losses of energy can occur in several places. A loss can be caused when the impact takes place between the striking object and the jar. If the jar is held by a very stiff mechanism, most of the energy will go into the holding mechanism, becoming unavailable for water hammer. If the headspace compresses to less than ¼ of its original volume, great losses of energy such as by heating must occur; some of the gas will go into solution in the liquid and finally, if the headspace is compressed even more, an inelastic impact takes place between the contents and the closure, causing a large loss. As the headspace expands again and the contents strike the bottom of the jar, more energy is lost by viscous flow of the liquid and collapse of the bubbles which have been formed during cavitation. Such losses of energy are important in practice because they tend to prevent the bottles and jars from breaking when they receive moderate blows from the top.

The five essential parts of the phenomenon of water hammer breakage are: the impacting mechanism, the container, the constraint on the container, the headspace and the contents. Each of these essential parts can have all sorts of qualitative variations, many of which can in practice vary over several orders of magnitude. For example, the qualitative factors of the contents are the viscosity, the absence or presence of suspended material, dissolved gas, etc. The quantitative variation of the viscosity ranges from 0.01 poise for water to about 1000 poises for stiff molasses.

The Impacting Mechanism

In order to produce water hammer in bottles, the top must be struck in some manner. The impact may be

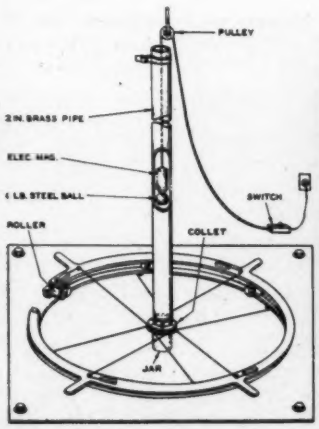


Fig. 40. Diagram of the water hammer testing machine used in the present work.

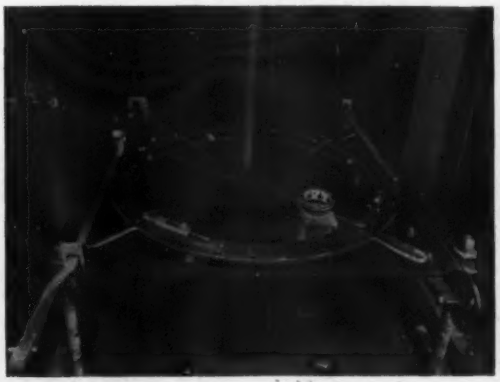


Fig. 42. Photograph of the water hammer testing machine showing the underside of the holding collet and the arrangement of the wires.

Fig. 41. Photograph showing tension adjustments of the water hammer testing machine.

Fig. 43. Checks caused by a cold conveyor belt touching the base contact point of the bottle, leading to Type V breakage. (See Fig. 33, Part II). (x 7).

described as to its efficiency of energy transfer, the duration of transfer, and the amount of energy put into vibrations. In order to determine these facts, it is practically necessary to know how the force varies with the time at the contacting surfaces.

When the impact is very sudden, the forces are very great for an extremely small interval of time. As a result, much of the energy goes into vibration, the finish of the jar is often broken, serious losses of energy take place, and the negative pressure[5], or hydrostatic tension, of the liquid tends to prevent the bubbles from forming.

When the impact is of moderate duration, little energy goes into vibration, the jar accelerates swiftly and a void is usually formed, making the conditions ideal for water hammer.

However, when the impact is of long duration, and the impacting forces are rather small, the headspace pressure prevents formation of voids between the jar and the contents, and water hammer cannot take place.

The commonly used cardboard cartons tend to dissipate energy thus making the impact less sudden and preventing finish breaks. However, as we have previously pointed out, when the carton is propped up it is possible to get sufficient energy into the container to cause breakage. Any sort of simulative test as with laboratory apparatus faces the difficulty of transferring the energy into the container at about the same speed as in the struck carton experiment, without having the inherently large inefficiencies caused by compressing the paper structure.

Unfortunately, as the velocity of an impacting weight is varied, the temporal relationship of the forces of impact is found to change also. In certain cases the nature of the water hammer may change considerably with different impacts of the same weight falling through different distances.

The Container as a Factor in Water Hammer Breakage

The container has several properties relevant to water hammer. These properties are weight, geometrical design, strength, and the nature of closure.

The design of a bottle determines its ability to vibrate under sudden impact. Thin-walled bottles and paneled bottles are most prone to these vibrations; on the other hand, a thick-walled bottle such as a Coca Cola is very difficult to set into vibration.

The shape of the bottle has certain possibilities of affecting the action of the contents under impact. If the neck of the bottle is small, some of the contents will have to flow around a corner at the time of impact, causing a certain amount of turbulence and thereby dissipating energy that might otherwise go into water hammer. With strong ware this effect becomes quite important in reducing the water hammer. Tests on the oscillograph show that increases in impact do not produce corresponding increases in the intensity of the water hammer by anything like the expected amount. Certain types of export beers are a good example of this type of bottle.

Other factors of design are the amount of rounding of the base, and whether or not the base is pushed up in the middle. When the base is pushed up in the middle, the intense local effects will strike very close to the junction of the base and sidewall. This will tend to make both Type V and Type VII breaks. As the base is flattened and the sidewalls drawn in, the pick action tends to be located further toward the middle of the base where it is not so destructive.

A further factor is the strength of the glass as affected by surface conditions. If the glass is weak because of checks or cracks, the general pressure effect is apt to cause breakage. As the strength of the outer surface of a jar is increased by reducing checks and bruises, the intense local effect becomes increasingly important as a cause of breakage.

Moreover, it is much harder to break a strong bottle or jar than would be expected. As the intensity of the impact is increased, the danger of breaking a finish is increased, the efficiency of the first impact becomes less, and the energy lost in compressing the headspace becomes very much greater. For these reasons, jars of only moderate actual differences in strength will often show tremendous apparent differences on the water hammer testing machine as well as in tests in cartons.

The Effect of Constraints on the Water Hammer Strength of Bottles

A constraint on a bottle is any device, with the exception of the contents, which influences the travel of the bottle after impact. Possible constraints include a wire suspension for the jar, a bottom stop, and a paper carton. When a carton is propped up on one side and struck, the action of the carton, and the stopping of the bending of the carton by the floor, are part of the problem of the constraints.

Fig. 44. Checks caused by ware touching together in the lehr. A serious fault leading to breakage of Types I, II and III. (Figs. 29, 30, and 31, Part II). (x 12½).

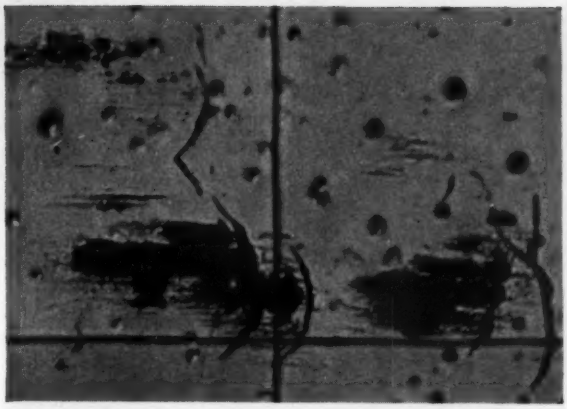


Fig. 45. Checks caused by ware rubbing against cold metal before entering lehr. A serious fault leading to breakage of Types I, II and III. (Figs. 29, 30 and 31, Part II). (x 50).

The greatest energy available for water hammer occurs when the constraint allows the bottle to move freely downward for half an inch or so, and then bounces it upward without any loss of energy. Unfortunately, this condition is approximately met when a carton is propped up one-half an inch to an inch on one end. For a given blow, some of the jars will be at just the right height above the floor to receive the maximum amounts of energy.

When stopping devices are used on water hammer testing machines, their effect varies greatly with the weight of the bottle used, the headspace pressures, and the energy of the impact, and they are exceedingly critical in adjustment. For these reasons, it is usually desirable to use as simple a constraint as possible so that its effect may be easily calculated.

The Headspace as a Factor in Water Hammer Breakage

The headspace may relevantly be described as to its size, shape, pressure of the gas inside, and the solubility of the gas. There must always be some headspace in order to allow for the thermal expansion of the contents, and this headspace is generally large enough to permit water hammer. When there is as much as one-half a cubic inch headspace, there is sufficient room to break practically the strongest bottle. When there is less headspace, it becomes increasingly difficult to break the stronger bottles; and when there is practically no headspace, water hammer breakage is practically impossible. The simplest tests on capped bottles will demonstrate this effect of the headspace.

The headspace pressure is usually a very important factor in driving the contents against the base. When the pressure is very great, it is quite hard to start water hammer, especially when the blow is struck at the top of the bottle with a soft object. As the pressure is decreased, it becomes easier and easier to start a water hammer. When the pressure in the headspace is about one inch of mercury, one can start a water hammer by merely jerking the bottle downward in the hand. Yet the intensity of the water hammer is very much less with low headspace pressure even though it is much easier to form. So there tends to be a minimum water hammer strength for some intermediate pressure between the range where it is hard to start and that where it has very little energy.

In actual practice, certain foods, such as some catsups, are packed at about the pressure which will give the minimum water hammer strength. A little more or quite a bit less vacuum in the headspace would considerably reduce the water hammer breakage.

A great many of the lighter weight bottles when badly bruised in process of manufacture or in service will stand practically no water hammer at all. So, when they are under a vacuum of 26 inches of mercury, they are much more liable to water hammer breakage than when they are under only 15 inches of mercury.

With strong bottles it becomes increasingly difficult to detect the minimum water hammer strength, as the headspace pressure is varied. When the pressure gets moderately low (25 inches of vacuum), some bottles break easily and some not at all; so the scatter of the data makes it difficult to determine an average with any real meaning.

It is quite evident from tests on headspace volume and pressure that with certain types of constraints there is a practical limit to the total amount of energy that can be made available for water hammer. This limit depends upon the volume and pressure of the headspace and the nature of the constraint used. With a free falling jar, it is quite possible to put this limiting amount of energy into the system without causing water hammer breakage. It is, therefore, possible to have spectacular differences in strength appear on the testing machine without corresponding changes in field breakage.

In all arbitrary water hammer tests it is essential that the effects of the headspace be considered.

Effect of the Contents on Water Hammer

The contents of bottles are so diverse that any systematic description of their properties affecting water

Fig. 46. Very shallow scratches produced by sharp metal edges of processing equipment. These do comparatively little damage. (x 33).

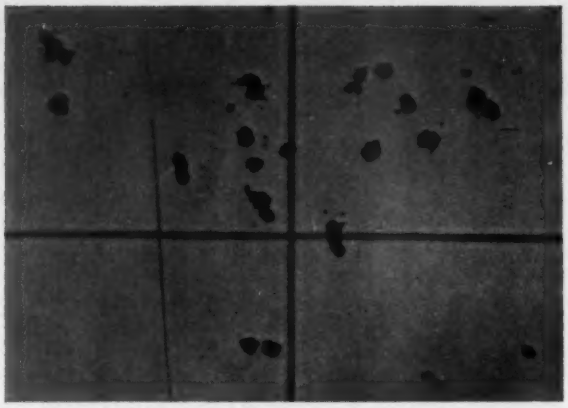


Fig. 47. Light surface abrasion caused by cold glass rubbing cold glass, particularly at inspection. This is relatively unimportant from the standpoint of water hammer breakage. (x 50).

hammer breakage is too big a field to cover in this paper. Some of the more important factors of the contents in water hammer breakage are the viscosity of the liquid, the dissolved gases, the bubbles of gas that are distributed throughout the contents, the compressibility of the contents, the amount and the sedimentation of the solid particles, and whether the contents are gels or liquids. In our investigation it soon became evident, with mixtures such as foods, that a complete description is quite impractical; but a discussion of some of the fundamental factors may prove useful.

In the case of water hammer breakage in wide mouth jars, capped at 22 inches vacuum, the viscosity of the liquid seems to be rather unimportant until it becomes greater than about 5 poises; then it soon becomes the controlling factor until water hammer breakage becomes practically impossible at about 100 poises. However, when headspace pressures are substantially changed, and narrow necked ware is used, viscosity may become a very important inhibitive factor even though it is less than 5 poises.

As has already been stated, the bubbles trapped inside the liquid are the nuclei for formation of the large bubbles at the time of impact. These bubbles may be variously located, or may be entirely absent. However, in the case of foods, they are nearly always present and their position at the time of impact is often a determining factor in the type of breakage that appears.

With a pure liquid that has been carefully degassed, the phenomenon of negative pressure[6] is easily produced, It can be shown on the oscillogaph that this phenomenon occasionally takes place.

Another factor is the compressibility of the contents which is often the controlling factor in the time the water hammer lasts. As an experiment, if sponge rubber balls are on the bottom of a container filled with water, they absorb the energy at such low pressures that water hammer beakage is practically prevented. A great amount of gas that is trapped in the form of small bubbles also produces this effect. When fine bubbles are whipped into jelly, this effect becomes very marked although the total volume change of the jelly is less than 2 or 3 per cent. The extreme instances of whipped cream or soap suds are the ultimate limit of this effect.

Most packed foods such as soups, catsups, etc., consist of solid particles suspended in a liquid. On standing, the solid particles tend to settle out on the bottom of the jar. When the water hammer takes place, this sedimentation often protects the bottom to such an extent that sidewall breaks become the rule. Various tests have shown that any sort of solid on the bottom of the jar helps reduce water hammer breakage, and nearly always prevents internal base rim breakage.

Thick gels tend to prevent water hammer breakege. Thin gels act in a very similar manner to pure liquids, increasing the internal base rim breakage considerably. Probably the final pick is greatly intensified because the surface of the gel tends to hold together much better than a simple liquid.

Methods of Testing the Water Hammer Strength of Glass Containers

The glass manufacturer will want some criterion of the ability of his ware to withstand water hammer breakage. During the past two years we have developed several tests and methods of examination of the ware by which an intelligent estimate of the ability of ware to withstand water hammer can be made. However, it is absolutely essential to have actual field breaks and a knowledge of the service treatment of the bottle. These must complement all results of laboratory studies which include tests on the water hammer testing machine, acid etching and inspection of new and used ware, and determination of the properties of the packed foods. With this information one is in a position to say whether some ware is better than others, and whether or not new, untried ware will be satisfactory, provided no radical change of design has been made. We have not as yet been able to design any simple test giving results not dependent upon the judgment of operators trained to the interpretation of this kind of breakage.

When a specific complaint concerning water hammer breakage comes to our attention, the first step is to classify the field breakage according to the various types previously mentioned. A hundred field breaks is none too many for a thorough preliminary study. The next step is to run tests on the water hammer testing machine,

(*Continued on page* 534)

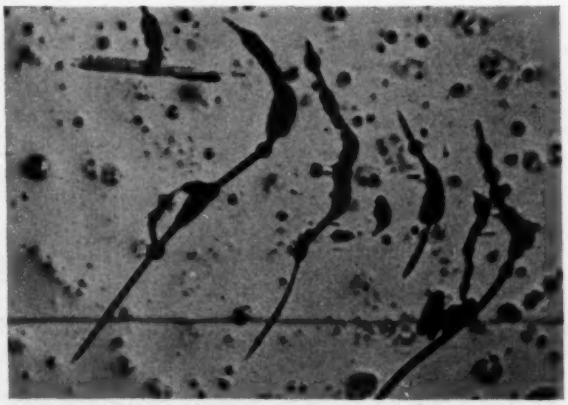


Fig. 48. Checks caused by ware rolling against cold metal before lehring. This produces weakness similar to those of Figs. 44 and 45. (x 50).

GLASS INDUSTRY PUBLISHER WITH BRITISH FORCES

John T. Ogden, editor and publisher of THE GLASS INDUSTRY, left New York early last month with a unit of the American Field Service, their destination presumably North Africa. Mr. Ogden became interested in the Field Service some time ago, and had helped to recruit and organize the ambulance unit in which he will hold one of the commands. Under a Geneva treaty, the members of the corps have non-combatant status. They had a large organization in France in World War I, and served there in World War II until the fall of Dunkerque. Mr. Ogden's brother, Alfred T. Ogden, accompanied him as a member of the unit.

Prior to Mr. Ogden's departure, his wife, Mrs. Katherine W. Ogden, was elected president of Ogden-Watney Publishers, Inc. Active management of the business is in the hands of Wallace F. Janssen, editor of *The Glass Packer*, and Cyril B. Delgado, advertising manager of THE GLASS INDUSTRY and its sister publication, *The Glass Packer*.

"THE STORY OF GLASS"

"The Story of Glass," the nineteenth of the Elementary Science Series of thirty publications, has recently been published through the efforts of the Federal Works Agency, Works Projects Administration for Pennsylvania, and co-sponsored by the Philadelphia Board of Public Education. Following a condensed history of glass making, the booklet describes modern processes in the glass industry, the recent development of new types of glass, and possible future utilization. It is intended, as others in this series, for classroom use and as a source of reference by school libraries for children of the third and fourth grades.

INQUIRY ON USE OF CULLET IN BATCH

Editor, THE GLASS INDUSTRY:

In 1935 Parmelee and Badger collected some data on the use of cullet in glass making. At that time, although there was a general feeling among glass manufacturers that an increase of cullet percentage in the batch should mean an increase in soda, only one manufacturer gave definite figures. This was for an increase of 5 lbs. Soda per 1000 of sand for a 15 per cent increase.

We have the feeling (with very little data to back us up) that at 1425°C. about .3 per cent Na_2O is volatilized per square foot of tank area per day.

We are wondering what the experience of others in the industry is today.

General Electric Company
R. W. Newman, Engr.
Pitney Glass Works No. 54

EDITOR'S NOTE: In attempting to answer Mr. Newman's letters, at least in part, THE GLASS INDUSTRY has prepared a review of previous work on this subject which will appear in the January issue. Additional comments, particularly those from a practical point, will be welcomed after the review is published.

DIAMOND ALKALI SUBSIDIARY

The Diamond Magnesium Company, Painesville, Ohio, has been formed as a subsidiary to the Diamond Alkali Company, Pittsburgh, Pa., and will operate a $16,000,000 magnesium plant for the government. The new plant is to be built adjoining the Diamond plant at Painesville. Raymond F. Evans, son of the founder of the Diamond Alkali Company, and formerly a vice president in charge of research of the company at Painesville, is president of the new subsidiary.

CORNING REPRINT

Electrical and radio engineers interested in the use and potentialities of glass as an insulating material will find useful coordinated information and data in "The Dielectric Strength of Glass—An Engineering Viewpoint." This recent study, by E. B. Shand, Corning Glass Works, Insulation Division, is now in reprint form. Mr. Shand's study was recommended by the AIEE committee on basic sciences and was presented at the AIEE North Eastern District spring meeting at Rochester, New York.

The study is organized under three main headings: I. Dielectric Failure of Glass. II. Factors Governing Failure. III. Curve Data. Tables and Data Curves include—Disruptive Strength; Graphic Representation of Breakdown Charateristics; Selected Dielectric Breakdown Data for Glass; Selected Breakdown Data for Porcelain; Oil Puncture Tests on Power Insulators; Dielectric Breakdown Characteristics of "Pyrex" Glass and Porcelain.

Copies may be obtained, without obligation, from the Corning Glass Works.

WANTED TO BUY

A consulting engineer wishes to arrange for the production of small spheres and thin glass flakes with suitable plant. Will furnish technical assistance if desired. Box 44, THE GLASS INDUSTRY, 11 W. 42nd St., N. Y. C.

INVENTIONS AND INVENTORS

A Summary of the Patents of Interest to the Glass Industry Issued During October

Furnaces

In a patent discussed in the October GLASS INDUSTRY, Kenneth B. McAlpine of Pittsburgh told of his method of freeing glass of small bubbles by trapping them in larger bubbles. As the glass flowed over a shallow section of the tank toward the fining end, such gases as carbon monoxide were bubbled through the tank bottom to exercise a sweeping action on smaller entrapped bubbles. This recent patent 2,254,079, has been followed by a second, 2,261,034, both assigned to Pittsburgh Plate Glass Co., in which the source of the purging gases is a combined nozzle and stirring head. While the stirring head is moved through molten glass in a tank or pot, a stream of gas is introduced below the surface of the glass through a nozzle at the tip of the stirrer.

Feeding, Forming, and Shaping

Shears of novel design were described in patents 2,259,763 and 2,259,764 assigned by George T. Meyers of Parkersburg to The Meyers Co. The main idea was that of giving the remaining sheared stub of glass a concave surface, so that this last-cut portion would be forced upwardly into the stream at the center where the glass is hottest, so that it would be reheated sufficiently to reduce shear marks caused by cooling. Figure 1 from patent 2,259,763 shows one means by which the shear blades 63 and 64 can be given a circular course which will produce the desired concave cut. A more complicated shear, from patent 2,259,764, also illustrated in Figure 1, consists of two concentric spheres whose cut leaves a concave spherical depression. The severed gob drops through an opening in the bottom of the two spheres.

Edward H. Bennett of Toledo has developed an improved cooling apparatus for the spindle of a rotary suction gathering blowing machine. In patent 2,259,991 (Libbey Glass Co.) he describes the orthodox practice in which a glass blank is dropped onto the upper end of a spindle which is provided with jaws for gripping the bottom of the blank and for blowing it into the desired form. During the inverting operation the blank is partially formed in the open air by a series of air puffs, the development of the blank being influenced by stationary manifolds which blow against the spindle in one or more positions. Bennett's improvements include the provision of cooling jets which, being mounted on the individual spindle frames, are free to tilt with it. The air supply is continuous so the spindle jaws and the blank are subjected to cooling during the entire open air development of the blank, instead of only at fixed positions.

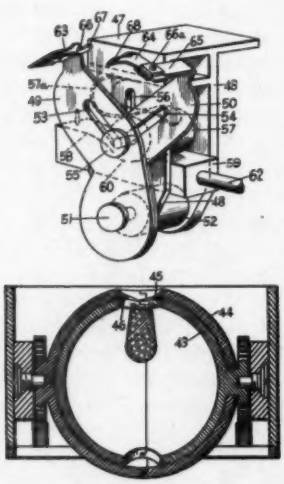


Fig. 1. 2,259,763 (above) and 2,259,764: Meyers. Two means of shearing so the stub will have a concave surface to allow reheating of the center material. The lower shears will have spherical surfaces.

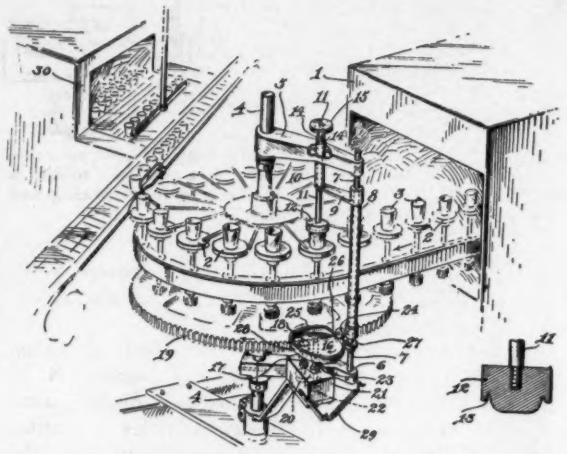


Fig. 2. 2,259,377: Haub. The fitter head at lower right is used to shape tumbler mouths 12 after fire-polishing.

The almost monthly addition to the Pittsburgh Plate Glass group of patents on cellular or vesicular glass is in this instance 2,261,022 which has issued to John H. Fox, Pittsburgh and Wm. O. Lytle, New Kensington, Pa. A number of processes are described but in general the plan is that of generating gas by decomposing calcium carbonate within molten glass to give it a cellular structure, and then drawing off the frothed product as a continuous sheet suitable for cutting into blocks.

A tool for shaping glass vials is described in patent 2,261,074 issued to Fred D. Pinotti, Kimble Glass Co., Vineland, N. J.

Miscellaneous Processes

Figure 2 shows George R. Haub's apparatus for perfecting the shape of the mouth of tumblers whose ill-shape would make it difficult to apply a tight fitting metal lid. As they leave the fire-polishing housing 1, a fitter mechanism detailed in the lower right hand corner of the illustration automatically enters each tumbler. This is patent 2,259,377, assigned to Hazel-Atlas Glass Co.

The interesting recent development of vaporizing fluorides to film-coat optical lenses to prevent certain types of reflections is the subject of John H. McLeod's patent 2,260,471 (Eastman Kodak Co.). He has designed an apparatus which supports many lenses at their edges, for rotation within a bell jar vaporizing chamber. The bell jar includes an electrically heated filament to evaporate the fluoride. The habit of the fluoride of depositing on the first surface it strikes, without diffusing evenly through the chamber, makes it necessary to take

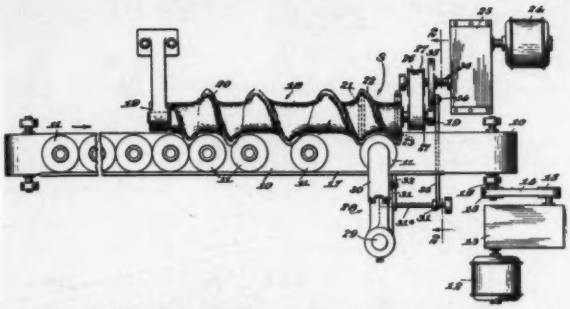


Fig. 3. 2,259,748: Hullhorst. The timing screw connects with bottles 11 moving to the right on a conveyor toward a labeling station 30, so as to first increase their spacing and then to retard them during treatment.

careful steps to provide for an ample exposure of all portions of the lenses. The rotating system also inverts each lense holder on a regular cycle.

The bottle inspection device described in patent 2,259,394 (Lawrence T. Sachtleben, of Camden, N. J., Radio Corp. of America) is intended to disclose automatically the presence of foreign particles in bottled drinks. Each container is rotated so as to bring the contents into motion and then the bottle is stopped. Any extraneous material moving within the bottle will interrupt a sharply focused light and actuate a photoelectric cell so as to indicate that the bottle needs to be discarded. The patent discloses improvements on this type of apparatus.

A hand glass cutter with steel cutting wheel was patented by Murray C. Eldredge of Chicago (2,260,706), and one which cuts by means of an electrical resistance element was patented by Joseph F. Turke of Collins, N. Y. (2,258,692). The heating element is supported by a wheel for rolling contact with the glass.

Figure 3 shows Wm. B. Hullhorst's method of controlling the motion of bottles on a conveyor so they can be labeled or otherwise treated at a stationary position. This is patent 2,259,748 assigned to Owens-Illinois Glass Co. The bottles, 11, moving to the right toward the labeling station 30, come under the influence of a timing screw 18 which first increases their spacing and then retards their motion during treatment.

Another Owens-Illinois patent, 2,259,777, granted to Verney G. Politsch and Albert G. Lauck, Alton, Ill., concerns improvements in apparatus for dropping pellets of sulphur into glass containers. This established practice provides a source of acid fumes in the lehr to neutralize the alkaline surface of the container and increase its resistance to acid liquids. The apparatus covered by this newest patent provides a photoelectric cell to actuate the controls which release a sulphur pellet as each bottle is conveyed into position to receive it.

Means of sealing the lead wires into a bulb to form a lamp are described in patent 2,259,165 issued to Samuel Karasick of Mount Vernon, N. Y.

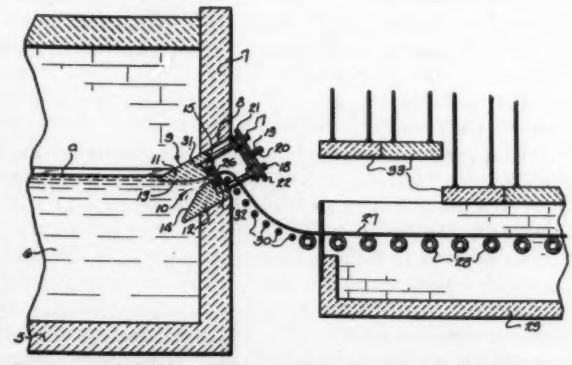


Fig. 4. 2,259,716: Zellers. Glass sheet formed by hydrostatic pressure which spouts the glass from an inclined slot.

Sheet and Plate Glass

Libbey-Owens-Ford received two patents for continuous horizontal flat sheet forming processes. The inventors were James T. Zellers of Toledo, Ohio (2,259,716), and Ernest B. Le Mare of St. Helens, England (2,259,755). In the Zellers patent, illustrated by Figure 4, the glass flows by hydrostatic pressure through an inclined slot in one wall of a tank, the sheet being carried away from the slot into a horizontal annealing lehr. The sheet forming member 9 is forced downwardly into the body of molten glass sufficiently to cause the glass to flow upward and outward through the slot 10. In effect the glass is caused to spout continuously under pressure through the slot to form the sheet. In being drawn away from the slot the sheet passes downward without support until it meets the series of rollers which carry it through the annealing lehr. The distance between the furnace and lehr is such that a surface skin forms on the sheet so that the rolls cannot mark it. Cooling pipes 30 may be used to assure this condition. The cross-section of the slot provides a greater thickness at the center and at each edge, the latter being particularly necessary so that the sheet will maintain its full width.

The Le Mare process of Figure 5 utilizes gravity flow from the fining tank, with rolls to form a sheet which is unsupported for a short distance. As illustrated, the support 8 does not extend entirely across the sheet but instead supports the sheet only at or near the edges. Without such supports it is reported that the edges of the sheet sag downward and are stretched out of shape. The skeletal nature of the Le Mare supports nevertheless allows substantial cooling of the sheet. The whole idea is that of keeping the sheet substantially free of any supporting means immediately following its formation, without any disadvantage due to sagging of the edges.

Vertical sheet drawing processes, particularly im-

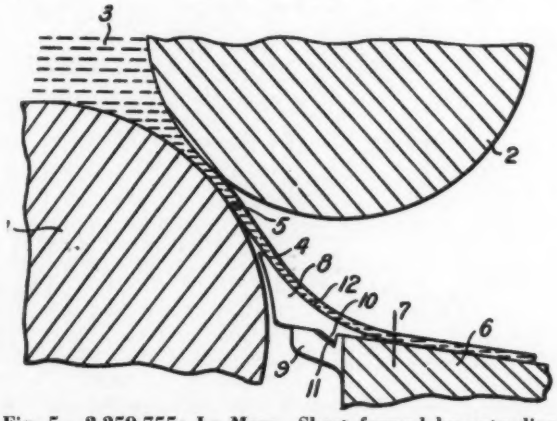


Fig. 5. 2,259,755: Le Mare. Sheet formed by extruding rolls is given edge support 8, to prevent sagging, but the center is unsupported.

proved to diminish waves or batter in the finished product, were contributed by two American Window Glass Co. patents. These were 2,258,121 granted to H. D. Menoher of Jeannette, Pa., and 2,258,118 to Pete Magrini of Belle Vernon, Pa. Both inventions may be explained by Figure 6 from Magrini's patent. The glass is drawn through a slot in the floater or debiteuse block 5, past water coolers 7 into the lehr 14. It will be noted that the coolers are joined to pipes 16 which form a contact with the floater block so as to prevent air rushing in and striking the glass at this point to injure its surface. The seal affected by these pipes in Magrini's apparatus makes it possible to substitute a controlled atmosphere of lateral moving gases for the normally injurious cross currents. Menoher likewise retards air movement toward the base of the glass sheet, but this method is to join the coolers to a heat resistant metal angle which bridges the space between the coolers 7 and the side walls of the drawing pit.

Tempering or case hardening processes were described in Libbey-Owens-Ford patents issuing to Harold E. Bowers (2,259,727) and to John L. Drake (2,259,741), of Toledo. The Bowers patent comments on the difficulty of satisfactorily tempering thin sheets of glass by the usual single heating and chilling treatment. He believes this is due to the fact that the thin glass cools so rapidly that not enough stress or tension is released above the strain point of the glass. His remedy consists in heating the glass as usual to a temperature between the strain and softening temperatures and then subjecting the heated sheets alternately to blasts of cold and hot air. The retarded cooling resulting from the hot blasts is said to keep the center of the sheet above the strain point long enough to permit more time for release of strain.

The Drake patent concerns a tempering furnace in which unique precautions are taken to avoid the exchange of air between the interior and outside which would normally occur in charging or drawing sheets from a tunnel-type furnace. The sheets are carried through in the usual tong suspended manner, but they enter the furnace vertically from underneath one end. They leave it in a similar manner at the other end.

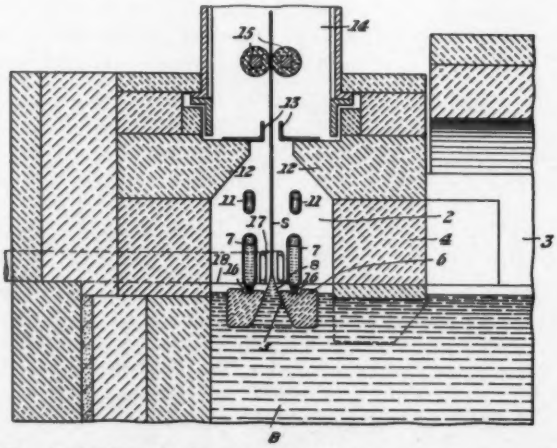


Fig. 6. 2,258,118: Magrini. Pipes 16 extending across the sheet drawing pit seal the cooler plates 7 to the floater block 5, to prevent counter air movement which would give the glass a wavy surfacee.

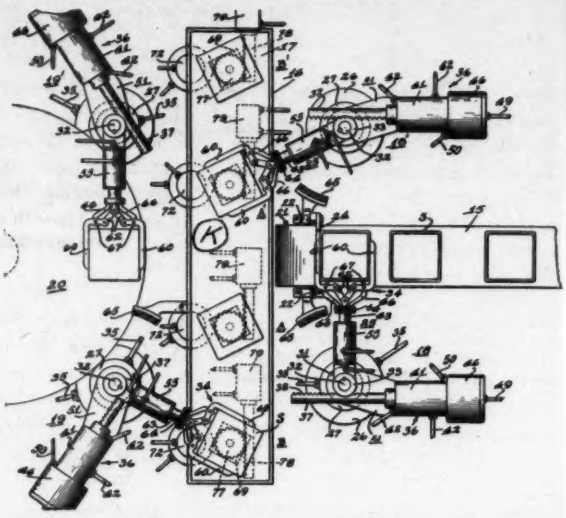


Fig. 7. 2,259,728: Bridges. Cupped halves of glass blocks picked up from the right hand conveyor are inverted and dipped into a container of molten sealing metal, and are positioned one upon the other on the table 20 where they are pressed together.

Glass bending apparatus is described in Pittsburgh Plate Glass patents 2,261,033 granted to Philip P. Marshall, Ford City, Pa., and 2,261,023 to Henry J. Galey, Tarentum, Pa. Marshall's patent, a division from 2,137,115 which issued in 1938, concerns a mold bed made of sand and clay smoothed off to the proper curvature by a template. The invention covers the use of lifting bars below the surface of the sand which may be lifted through the sand to remove the bent glass sheets. They are then replaced and the sand is smoothed for reuse. Galey uses a steel frame for the support of his sheets during bending. The sheets are supported only at their edges and could sag excessively in their centers if the bending was not arrested as by dropping the temperature at the proper point.

To eliminate the hand cutting of sections from glass sheet drawn vertically by continuous processes, Leslie A. Hinkle of Clarksburg, W. Va. (Rolland Glass Co., 2,260,-103), has developed an automatic cut-off machine. The cutter is supported by a carriage which has an adjustable stop which engages the top edge of the vertically moving sheet, so that the carriage and sheet will move upward together, while the sheet is being automatically scored for breaking. Patent 2,259,765 assigned by Joseph R. Morris of Toledo to Libbey-Owens-Ford Glass Co. concerns an apparatus for automatically breaking glass sheets after they have been scored.

Patent 2,258,991 granted to James G. McNally of Rochester (Eastman Kodak Co.) refers to a laminated glass product in which two sheets are separated by a three-layer plastic of which the middle one is a polymerized methyl acrylate and the two outer layers are cellulose acetate. Carl M. Langkammerer of Wilmington, Del. (E. I. duPont de Nemours & Co., 2,258,708), provides glass surfaces with a highly water-resistant coating, by applying a composition which contains an alkkyd resin to form a film, and a second composition containing a phenol-aldehyde resin. The process is completed by baking. (*Continued on page* 536)

CURRENT STATISTICAL POSITION OF GLASS

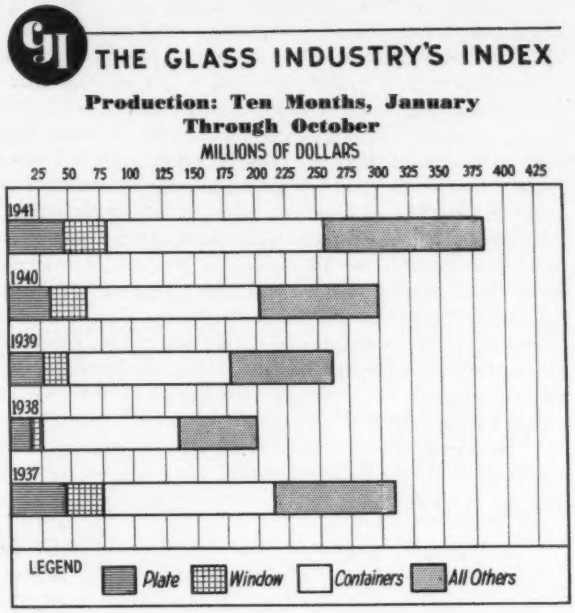
During October the glass industry operated at a rate which exceeded all previous records including those of recent months; in line with this trend, employment and payrolls also reached new peaks. According to THE GLASS INDUSTRY's Production Index, output during October totalled $45,000,000 bringing this year's 10 month's figure up to $383,000,000 as compared to $300,000.000 last year.

Plate glass production during October totalled 15,768,740 square feet according to the Plate Glass Manufacturers of America. This was 6 per cent greater than the previous month's total but was 7 per cent less than in October 1940. During the first 10 months of 1941, plate glass output amounted to 165,815,948 square feet as compared to 130,821,058 square feet in last year's comparable months—an increase of 27 per cent.

Window glass production during October totalled 1,523,984 boxes which was 36 per cent above the previous month's level and exceeded 1940's corresponding month by 13 per cent. Cumulative figures for the January-October period indicate an output of 13,557,000 boxes or a gain of 24 per cent over last year. During October the window glass industry operated at 93.9 per cent of capacity.

Glass container production during October totalled 7,093,615 gross according to the Glass Container Association of America. This was 13 per cent greater than the September total and exceeded October 1940 by 46 per cent. During the first 10 months of this year production totalled 58,211,135 gross as compared to 45,710,000 gross in last year's corresponding period. These figures indicate that productive activity in this branch of the glass industry has been 27 per cent greater than last year.

Shipments of glass containers during October decreased 9 per cent from the previous months total to 6,314,693 gross; however, this was 31 per cent greater than the October 1940 total. Outstanding gains were reported over last year's corresponding month for beer bottles, which were 5 times the 1940 volume and pressure and non-pressure ware which was tripled. Sales of



general purpose ware were up 47 per cent, and milk bottles 42 per cent; other increases ranged from 2 to 37 per cent. A 75 per cent decrease was recorded in sales of domestic jelly glasses while domestic fruit jars were off 25 per cent and narrow neck food containers, 19 per cent. Cumulative figures for the January-October period indicate that this year's shipments have exceeded 1940's volume by 32 per cent, having established the record volume of 58,777,552 gross. An analysis of the trends in individual lines reveals that all types of containers have made substantial gains—domestic fruit jars 97 per cent, beer bottles 50 per cent, domestic jelly glasses 40, pressure and non-pressure ware 39 per cent, general purpose ware 38 per cent, milk bottles 35 per cent, wide mouth food containers and liquor ware 29 per cent, medicinal and toilet ware 25 per cent, narrow neck food containers 22 per cent and pressed food ware 19 per cent.

Inventories of glass containers were 14 per cent lower at the close of October as compared to last year's corresponding date. Stocks of all types of ware have de-

CURRENT GLASS CONTAINER STATISTICS

(ALL FIGURES ARE IN GROSS)

Types of Ware	*Production*		*Shipments*		*End of Month Stocks*	
	Oct., 1941	*Oct., 1940*	*Oct., 1941*	*Oct., 1940*	*Oct., 1941*	*Oct., 1940*
Food Containers (Narrow neck, wide mouth, and pressed)	1,888,979	1,358,575	1,709,686	1,412,528	1,912,112	2,114,270
Pressure and Non-Pressure Ware	389,812	192,529	311,950	105,657	518,766	688,525
Beer Bottles	349,797	112,053	427,773	104,533	404,242	564,735
Liquor Ware	1,428,074	1,164,495	1,042,761	1,030,544	1,709,249	1,596,050
Medicinal and Toilet Ware	2,140,126	1,441,670	2,038,448	1,608,021	2,419,078	2,927,912
General Purpose	487,068	333,091	472,235	321,868	406,537	586,995
Milk Bottles	337,293	213,197	285,394	200,714	339,403	336,704
Fruits and Jellies	50,527	25,174	9,715	13,691	198,705	395,870
All Other	21,939	23,195	16,371	18,237	39,526	35,874
Total, Industry	7,093,615	4,863,979	6,314,693	4,815,793	7,947,618	9,246,935

clined with the exception of liquor ware which is up 3 per cent and milk bottles one per cent.

Miscellaneous glass products manufactured during October were valued at $16,000,000, compared with $13,000,000 in October 1940.

Machine-made tumbler production during October amounted to 4,836,548 dozens, which was 24 per cent greater than 1940's corresponding month. During the first 10 months of this year tumbler output totalled 44,001,910 dozens—18 per cent above last year's level. Shipments during October increased 36 per cent over October 1940 to 4,936,686 dozens, bringing the January-October total 22 per cent above 1940's comparable period to 6,974,951 dozens, which was 13 per cent less than last year's corresponding figure.

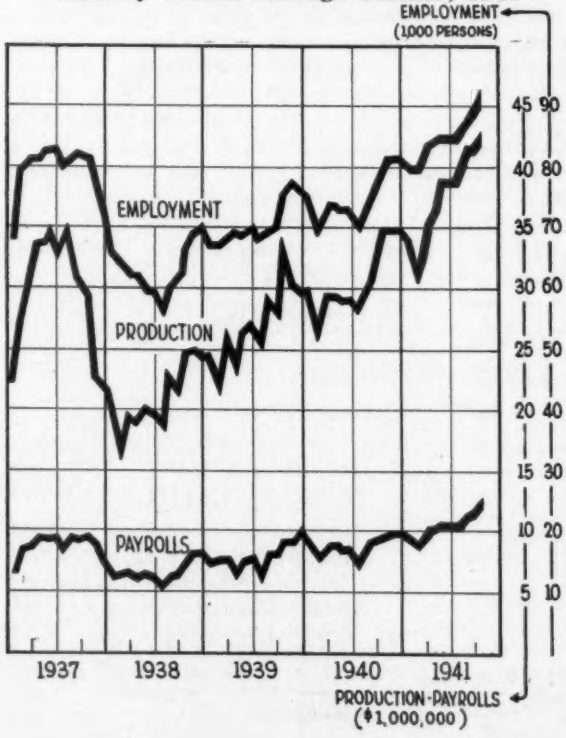
Manufacturers' sales of machine-made table, kitchen and household glassware totalled 4,081,759 dozens or 9 per cent more than a year ago. For the 12 month period ending October 31, 1941, this trade amounted to 38,715,696 dozens—14 per cent more than the previous 12 month total of 33,828,209 dozens.

Employment and Payrolls: During October 93,000 persons were employed in the glass industry, which set a new record. This compares with 90,000 in September and 79,000 in October 1940.

Payrolls in the glass industry duing October reached a new level of $13,000,000; in 1940's corresponding month, this payroll totalled $9,500,000. Glass manufacturers paid out $109,000,000 in wages during the first 10 months of 1941; last year's comparable total was $84,000,000.

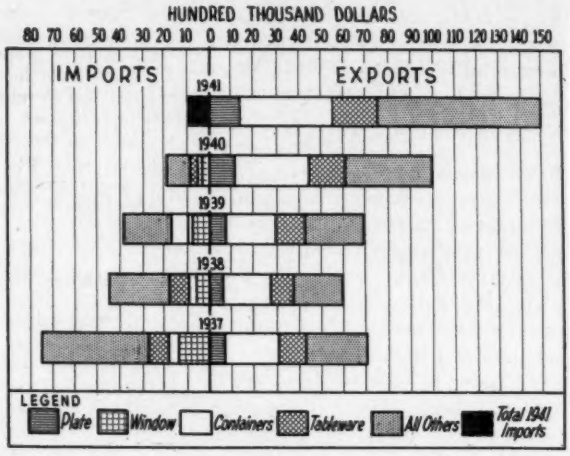
GI THE GLASS INDUSTRY'S INDEX

Monthly Trends Through October, 1941



GI THE GLASS INDUSTRY'S INDEX

Foreign Trade: Nine Months, January Through September



Foreign Trade: Exports of glass and glass products during September reached a record monthly level of $2,014,000 according to official figures released November 15th by the Department of Commerce. This was 12 per cent greater than the August total and exceeded September of last year by 82 per cent. This gain over the previous month was due to increases of 3 per cent in containers, 73 per cent in illuminating ware and 37 per cent in miscellaneous glass products which counteracted declines of 5 per cent in plate glass, 3 per cent in window glass and 14 per cent in tableware. Comparison of these figures with 1940's corresponding month reveals that there was an expansion in foreign sales of all glass products. Containers were up 80 per cent, illuminating ware 83 per cent, tableware 53 per cent, plate glass 15 per cent and window glass exports were 3 times the September 1940 volume. During the first 9 months of this year exports totalled $15,018,000 as compared to $9,987,000 in 1940's comparable months.

Imports of glass and glass products during September were 28 per cent higher than in August, recording a volume of $141,000; this was 10 per cent below the September 1941 level. During the January-September period imports totalled $1,023,000 or 48 per cent less than last year's figure of $1,963,000.

FOREIGN TRADE STATISTICS

(Values in $1,000)

Exports	*September* 1941	*August* 1941	*September* 1940
Plate	143	151	124
Window	201	208	68
Containers	525	508	280
Tableware	262	303	172
Illum. Ware	95	55	52
All other	788	574	412
Total	2,014	1,799	1,108
Imports			
Total	141	110	157

NEW EQUIPMENT AND SUPPLIES

AMPULE SEALING MACHINE

A 25 head ampule sealing machine is now being marketed by the Eisler Engineering Co., of Newark, N. J. This machine is adaptable for various sizes of ampules by placing larger or smaller bushings into chucks. These chucks continuously rotate at approximately 100 RPM. The fires are adjusted vertically by means of a handwheel. This machine seals-in 5 ampules at one time; one operator can seal-in approximately 2000 to 3000 ampules per hour. The machine requires a ¼ hp motor, ½ lb. gas pressure and 2½ lbs. of air pressure. The gas and air are regulated by valves. This machine can also be utilized for sealing-in the ends of small diameter glass tubing.

DeVILBISS RESPIRATOR

A new respirator, which is said to afford maximum protection against the inhalation of pneumoconiosis-producing and nuisance dusts, has just been announced by the DeVilbiss Co., Toledo, Ohio. Approved by the United States Bureau of Mines, the new respirator is said to embody new unique features. These features combined, make it more compact, lighter, easier to breathe through, more comfortable to wear, and easier to clean and maintain than previous models.

A compactly designed multi-vaned cartridge, measuring 2⅞ by 1½ inches and weighing one ounce, provides more than 41 square inches of breathing and filtering area. The filter is easily cleaned by blowing accumulated dust from vanes with an air dusting gun or nozzle, thus maintaining peak performance and requiring less frequent replacement.

WABASH HEAT LAMP

A new type of infra-red heat lamp developed in the Birdseye Research Laboratories of the Wabash Appliance Corp., Brooklyn, N. Y., has just been announced. The new bulb is designed to put to practical use for heating what is termed "spilled heat." It is pointed out that although the many efficient heating reflectors provide convergent, parallel or divergent heat beams as needed, there is still an average of 25 per cent of the heat rays that are spilled outside of any reflector and thereby lost. The new "bullseye" type of Birdseye Heat Lamp is said to control these "spilled heat rays" and to put them to work for heating even when present reflector equipment is utilized. The new bulb is distinguished by a ring lining of pure silver sealed inside the bulb at a point just below the focal point of the filament. This silver ring leaves a clear bullseye spot through which heat beams are projected from the filament direct to the heating area without spill or loss. All remaining heat rays, including what were formerly spilled heat rays, are now gathered into the control area of the reflector by the silver ring lining, and projected down to the heating area.

A special feature is the mechanical strap-in base made heat-proof to keep the base from loosening up under the terrific heat developed in infra-red tunnel installations. The lamp will be available in the 250 watt size, tungsten filament only, will fit the standard Edison screw socket, and will have an average burning life in excess of 5,000 hours.

SYNTHETIC SPONGE RUBBER

To fill requirements of a wide range of applications where oil, grease or other solvents which deteriorate natural rubber rapidly are present, The B. F. Goodrich Company, Akron, Ohio, announces a new sponge rubber made made from its synthetic rubber, Ameripol. Exhaustive tests have proved that Ameripol has extraordinary resistance to oils, greases and many other solvents, as well as a higher degree of temperature than natural rubber.

The new Ameripol synthetic sponge rubber is in the same manufacturing classification as milled sponge made from natural rubber. Sodium bicarbonate or a similar blowing agent is turned into gas by the heat of vulcanization and thus produces a cellular structure.

C-H DRUM CONTROLLERS

A new line of drum controllers for small cranes and hoists is announced by Cutler-Hammer, Inc., Milwaukee, Wis. Small and compact in size, these new drums have several features of outstanding interest. A rope operating lever, embodying a new Equalized Torque principle, entirely eliminates cumbersome sheave wheel, rope guard and external return spring, and provides smooth, easy operation even when the rope is pulled at an angle. A new Anti-Plug feature increases drum life by making it impossible to whip drum from full forward to full reverse position. Drum can be reversed quickly, but yet a definite time delay is required in the off position.

These new drums, Bulletins 5443, 9445 and 9447, are available in self-centering rope lever, self-centering and non-self-centering radial lever types, for four or six speeds.

VARIABLE SPEED CONTROL

A V belt variable speed transmission known as the JFS-Cub is being introduced to industry by Standard Transmission Equipment Company, Los Angeles, California. The JFS-Cub is especially designed for all "A" section V belt applications and for speed ranges up to 3.3-1. Smooth sided pulleys are used rather than the inter-locking type. Among the advantages claimed are: the patented positive belt alignment feature which makes possible the mounting of the "Cub" in any and every position withoupt impairing function or throwing belts out of alignment; machined and balanced cast iron construction, forced lubrication of the special bronze bearings on which the pulleys rotate; free-end pulley spindle to permit easy installation of belts; both pulleys on one side of pivotal mechanism which permits motor pulley and driven pulley to be almost directly in line with each other; etc.

The JFS-Cub is being introduced as a low cost speed control to make possible application on machines that never before could have the advantages of infinite speed selection because of expense. The "Cub" will transmit full capacity of "A" section V belts, and can be used with all machines now using that size.

CATALOGS RECEIVED

Amsler-Morton Co., Pittsburgh, Pa. A booklet commemorating the 25th Anniversary of the Amsler-Morton Company, engineers and contractors to the glass and steel industries. The 24 page booklet is illustrated with scenes depicting the firm's work and expansion. Copies of this booklet are available by writing to the company's home office, Fulton Building, Pittsburgh, Pa.

Aget-Detroit Mfg. Co., Detroit, Mich. A four page folder, "Stop Dust With The Dustkop," showing what the manufacturer claims is one of the most compact, lowest cost self-contained unit dust collectors. Specifications of the unit together with illustrations indicate how the unit is located to collect dust from different types of grinders.

Brown Instrument Co., Philadelphia, Pa. Bulletin 92-4, "Brown A.C. Analy-Graph." This 14 page illustrated bulletin explains in detail the features of the A.C. Analy-Graph, together with other factual data.

Hays Corporation, Michigan City, Ind. A 20 page booklet, "Draft—What, How, Why." Another Hays contribution to the practical understanding of boiler room instrumentation and control.

CATALOG & BULLETIN SERVICE

Current catalogs and manufacturers' service bulletins reviewed in this department may be obtained by writing to THE GLASS INDUSTRY.

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

Base Materials

		Carlots	Less Carlots
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	....	....
Precipitated material		55.00	60.00
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00–16.00	18.00
Borax ($Na_2B_4O_710H_2O$)	lb.	....	....
Granulated	In bags, lb.	.0215	.027 –.0295
Powdered	In bags, lb.	.024	.0295–.032
Boric acid (H_3BO_3) granulated	In bags, lb.	.048	.054 –.0565
Calcium phosphate ($Ca_3(PO_4)_2$)	lb.	.07	.07½
Cryolite ($Na_3Al\ F_6$) Natural Greenland (Kryolith)	lb.	.950–.975	.10
Synthetic (Artificial)	lb.	No supplies available.	
Feldspar—(published list prices)			
20 mesh	ton	11.00–13.25	
40 mesh	ton	11.50–13.75	
Granular	ton	11.75–14.00	
Semi-granular	ton	11.00–13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags.			
Fluorspar (CaF_2) domestic, ground, 96–98% (max. SiO_2, 2½%)			
Bulk, carloads, f. o. b. mines	ton	32.00	....
In bags	ton	33.60	45.00–48.00
Kryolith (see Cryolite)			
Lead Oxide (Pb_3O_4) (red lead) (N. Y.)	lb.	.0835	....
In 5 Ton lots	lb.	....	.0875
Less than 5 Tons	lb.	....	.0925
Lime—			
Hydrated ($Ca(OH)_2$–MgO) (in paper sacks)	ton	8.50	8.50
Burnt (CaO–MgO) ground, in bulk	ton	7.00	....
Burnt, ground, in paper sacks	ton	9.00	9.00
Burnt, ground, in 180 lb. drums	Per drum	1.60	1.70
Kiln Dried ($CaCO_3$–$MgCO_3$) 10x30 mesh.	ton	1.75	....
Kiln Dried ($CaCO_3$–$MgCO_3$) 16x20 mesh.	ton	1.75	....
Nepheline Syenite, f. o. b. shipping point	ton	12.50	16.00
Potassium carbonate—			
Calcined (K_2CO_3) 96–98%	lb.	.065	.0675
Hydrated 80–85%	lb.	.055	.0575
Salt cake, glassmakers (Na_2SO_4) in bags	ton	18.00–20.00	25.00
in bulk		16.50	
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat Per 100 lb.	.95	....
In barrels	Per 100 lb.	1.35	....
In Paper bags	Per 100 lb.	1.10	....
In Burlap bags	Per 100 lb.	1.15	....
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls	Per 100 lb.	....	3.00–3.40
95% and 97%			
Bulk	Per 100 lb.	1.35	....
200 lb. bags		1.4675	1.48
100 lb. bags		1.475	1.50

Special Materials

		Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)	lb.	.031–.034	.045
Aluminum oxide (Al_2O_3)	lb.	.07	.09
Antimony oxide (Sb_2O_3)	lb.	.15	.15½–16
Arsenic trioxide (As_2O_3) (dense white) 99%		....	.10
Barium nitrate ($Ba(NO_3)_2$)	lb.	....	Open price.
Pyrophyllite, (20% Al_2O_3)	ton	10.00	13.00
Sodium fluosilicate (Na_2SiF_6)	lb.	....	....
Tin Oxide (SnO_2) in bbls	lb.	....	.55
Titanium Oxide (ceramic grade) (Priority)			
In bags	lb.	.14½	.14¾–.15¼
In barrels	lb.	.14¾	.15 –.15½
Zinc Oxide (ZnO)			
American process, bags	lb.	.07	.07¼
White Seal, 150 lb. bbls	lb.	.09	.09¼
Green Seal bags	lb.	.08¼	.08½
Domestic White Seal bags	lb.	.08¾	.09
Red Seal, bags	lb.	.07¾	.08
Zircon			
Refined Granular (Milled .01–.02c. higher)		.06½	.07–.08

Coloring Materials

		Carlots	Less Carlots
Barium selenite ($BaSeO_3$)	lb.	....	1.40–1.60
(Commercial, 25% Selenium)	lb.	....	.85
Cadmium sulphide (CdS)	lb.	....	1.10–1.15
Cerium hydrate— 100 lb. drums and 600 lb. barrels	lb.	....	.60
Chrome Oxide Green, 400 lb. bbls	lb.	....	.25–.28
Chromite (99% through 200 mesh)	ton	55.00	58.50
Chromite ore (air floated)	ton	55.00	58.50–73.00
Cobalt oxide (Co_2O_3)			
In bbls. 350 lbs. or more,	lb.	....	1.84
Less than 350 lbs.,	lb.	....	1.94
Copper oxide—			
Red (Cu_2O)	lb.	....	.20–.22
Black (CuO)	lb.	....	.19–.22½
Black prepared	lb.	....	Open price
Iron Oxide—			
Red (Fe_2O_3)	lb.	....	.06–.10
Black (Fe_3O_4)	lb.	.04½	.09
Iron Chromate	lb.	....	.035–.05
Lead Chromate($PbCrO_4$) in bbls	lb.	....	.16
Lithium Carbonate	lb.	....	1.25
Manganese, Black Oxide (Caucasian)			
In Paper bags	ton	70.00	78.00
In Burlap bags	ton	71.75	79.75
In Casks	ton	74.00	82.00
Neodymium oxalate, 50 lb. drums	lb.	....	4.00
Nickel oxide (Ni_2O_3), black	lb.	....	35–.40
Nickel monoxide (NiO), green	lb.	....	.35–.37
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals and Granular	lb.	.09½	.09¾–.10
Powdered	lb.	....	.10¼–.10½
Potassium Chromate (K_2CrO_4) 100 lb. kegs	lb.	....	.27
Powder blue	lb.	....	.21–.25
Rare earth hydrate—			
100 lb. drums	lb.	....	.35
325 lb. barrels	lb.	....	.30
Selenium (Se) In 100 lb. lots	lb.	....	1.75
In lesser quantities	lb.	....	1.85
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.07½	.07½–.07¾
Sodium chromate (Na_2CrO_7) Anhydrous	lb.	.08½	.08⅞–.09½
Sodium selenite (Na_2SeO_3)	lb.	....	1.50–1.65
Sodium uranate (Na_2UO_4) Orange	lb.	....	1.65
Yellow	lb.	....	1.65
Sulphur (S)—			
Flowers, in bbls	Per 100 lb.	3.40	3.75–4.15
Flowers, in bags	Per 100 lb.	3.05	3.40–3.80
Flour, heavy, in 250 lb. bags	Per 100 lb.	2.95	3.30–3.70
Uranium oxide (UO_2) (black, 96% U_2O_6) 100 lb. lots. Black	lb.	....	2.55
Yellow orange	lb.	....	1.65

Polishing Materials

		Carlots	Less Varlots
Emery, Turkish	lb.	.075	.08
Pumice Stone,			
American Ground FFF, FF, F	lb.	....	....
0, 0½, ½, 1	lb.	....	....
Putty Powder	lb.	Open price.	
Rotten Stone, (Domestic)	lb.	.02¼	.03½
Rouge, Red	lb.	.18	.16
Black	lb.	.15	8

"Ceramic" COLORS BEAUTIFY GLASSWARE

• Uniform, dependable, easy-to-apply "Ceramic" Colors add beauty and sales appeal to glassware.

Especially controlled to give smooth performance under specific operating conditions, "Ceramic" Colors are tailor-made to your individual requirements.

Let us know your needs. Use the following listing as a guide to more profitable color application.

WRITE, WIRE, OR PHONE YOUR INDIVIDUAL REQUIREMENTS

GLASS COLORS

Banding	Acid-resisting
Spraying	Satin Finish
Screening	Low Fire
High Fire Convexing	Weather-resisting Enamels
Alkali-resisting	Ices
Decalcomania	Batch Colors

CHEMICALS

Aluminum Hydrate	Fluorspar
Antimony Oxide	Cryolite
Arsenic Oxide	Manganese Dioxide
Barium Carbonate	Powder Blue
Bone Ash	Potassium Bichromate
Cadmium Sulphide	Sodium Antimonate
Cerium Hydrate	Sodium Uranate
Chromium Oxide	Sodium Selenite
Cobalt Oxide	Sodium Silico Fluoride
Copper Oxide	Selenium
Iron Chromate	Titanium Dioxide
Iron Oxides	Zinc Oxide

DECORATING SUPPLIES

Balsam Copaiba	Ground Laying Oil
Oil of Copaiba	Printing Compounds
Venice Turpentine	Brushes
Damar Varnish	Spray Equipment
French Fat Oil	Palette Knives
Squeegee Oil	Paste Mills

"Ceramic" COLORS

CERAMIC COLOR & CHEMICAL MFG. CO.

NEW BRIGHTON, PA., U.S.A.

(*Continued from page* 524)

which is essentially a device to give a sudden acceleration to a jar, and put in kinetic energy in a controlled and measurable manner.

The test method which was finally adopted is to drop a weight onto the cap of a bottle or on the shielded cap of a jar from a measured distance above bottle or jar. The jar is held and centered by an ingenious device, designed by Mr. Donald G. Merrill of the Hartford-Empire Company, in which four wire loops hold the jar. A collet between the wire and the jar insures good alignment.

A diagram of the apparatus is shown in Figure 40 and a photograph in Figure 41; the holding wires and collet appear more clearly in Figure 42.

In operation, the jar or bottle is centered directly under the tube, and the tension on the supporting wires is then equalized. Once the wires are properly adjusted, several hundred tests can be run before further adjustments are necessary. The jar is inserted in the collet. The weight is raised to the required height by the tackle on the magnet and then dropped.

This type of testing machine is very convenient to use, yet it has certain fundamental difficulties which prevent it from giving anything but comparative results. As long as the ware has the same weight and shape, comparative tests will be satisfactory. However, if changes are made in the weight and shape, it becomes difficult to make comparisons because the constants of the machine cannot readily be determined. We have given some consideration to the design of a machine that would make possible the systematic comparisons of different types of ware, but have not had an opportunity to complete this phase of the project.

It is generally necessary to run the tests with the foods that are normally packed in the ware, because the contents determine the probability of the pick effect striking in any one zone, and the relative magnitude of the pick effect compared with the general pressure effect. It is also necessary to get the foods into exactly the same physical state they are in when they experience water hammer in the field. The headspace pressure, the number and position of the trapped air bubbles in the food contents, and the amount of sedimentation of the foods should be identical with the field conditions.

After a single impact it is, of course, impossible to make a second test on a particular jar until it has settled out for at least 24 hours, because even the first single water hammer stirs up the settled out food particles. When a certain type of ware had been packed with foods and allowed to settle, it was possible to get 100 per cent Type I and II breaks with a single impact on the laboratory testing machine as compared to 97 per cent of these types in field breaks. However, when the same ware was filled with water and subjected to test, about 90 per cent of the breaks were Type VII.

In another series of tests on new jars, when the contents were shaken up, all the breaks were on the internal base rims and the 50 per cent breakage level was around 24″ drop of ball on our testing machine. When the bottom was protected either by having foods settle out or by putting sealing wax on the bottoms, all the breaks were on the sidewall and only about 25 per cent of the jars were broken when the ball was dropped 204″. So that protecting the bottoms of the jars as in actual use, made them more than ten times as strong.

In the case of certain very weak ware, when the tests were made with a rubber cushion on top of the holding collet the initial breakage was always at 18″, and yet nearly 50 per cent of the bottles broke at this value. On the other hand, when the rubber cushion was removed, the initial breakage dropped to as low as 6″, and the 50 per cent level only dropped to 15″. The cause of this change was that water hammer did not form at the lower impacts, with the rubber cushion in place. Removal of the cushion made the impact more sudden so that water hammer could form at drops as small as 6″.

The greatest difficulty in laboratory testing lies in the time and equipment required to fill jars with food of correct consistency. If the jars are merely filled with cooked food, fermentation usually takes place before sufficient time has elapsed for settling. If the jars are filled with canned food, and then autoclaved, the second sterilization completely changes the consistency of the food. If raw food is available, great care must be used to get it properly degassed, and to obtain the same proportions of soluble and insoluble solids as in the commercial product.

Another very valuable test is to etch the bottles with hydrofluoric acid until scratches and checks show up quite clearly. Under such conditions visual examination immediately detects whether the ware has been badly damaged. For actual production control such a test, in combination with routine examination of cut sections should be all that is necessary in the hands of an experienced man, as long as the ware remains reasonably good. However, when checks appear in the glassware, further tests should be applied immediately in order to save some of the production from the cullet heap.

The question has often arisen as to whether or not a pressure test would give a satisfactory measurement of the water hammer strength. If the origins of breakage in the pressure test occur at the same place as the origins in the field breakage, we may expect good correlations to exist. However, this is generally not the case, so that the correlations between the pressure tests and the amount of field breakage are usually exceedingly poor.

Methods of Reducing Water Hammer Breakage

The strength of a glass container depends primarily upon the surface conditions of the glass, and in a secondary manner upon such things as weight, design, distribution and annealing. In all tests on the strength of glass containers it has been practically impossible to discover variations in strength caused by slight changes in these secondary factors. The uncontrolled variations in surface damage have tended to mask the results completely and water hammer tests are no exception. However, when radical changes are made, which affect the stress existing in the glass at the time of breakage by 20 per cent or more, we are usually able to discern definite differences in our test results.

Increasing the weight of a jar will increase the strength if the other factors are kept constant. Mathematical considerations lead us to believe that when the pick effect is responsible for external sidewall breakage such as Type I and Type II, the strength will vary with the square of the thickness at the point of the origin, so that light-

weight containers will show a disproportionate amount of water hammer breakage.

The optimum practical design for a jar to resist water hammer breakage is a cylinder with slightly rounded bottom corners and a sidewall tapering in thickness and becoming considerably heavier at the base than at the shoulder. However, since the shoulders are used as a fulcrum when caps are pried off, it is usually better to dispense with the taper and make the shoulder strong enough to prevent breakage when the jar is opened. Rounding off the corner of the base is chiefly beneficial in producing better distribution of the glass and preventing a sharp corner from damaging other containers in the process of inspection or during handling. The addition of fluting and other complicated designs, or square or rectangular shaped bottles, will usually decrease water hammer strength. If the contents are very liquid, as is the case with grape juice, the Type VII origin at the internal junction of the base and sidewall is likely to occur. In such a case severe rounding of the bottom of the jar, and increasing the thickness of the rim of the base, are helpful in preventing breakage. In designing a jar resistant to water hammer it will probably be best to start with a cylindrical shape having slightly rounded corners and then make such modifications as may be suggested by examination of field breakage.

The effect of distribution on breakage by water hammer becomes important when thin spots occur in those regions where the pick effect strikes and the outer surfaces are checked. Since it is necessary for these other two conditions to exist simultaneously before differences in strength can be noticed, it is quite possible to establish test conditions where thin spots have apparently no effect. So it is generally necessary to duplicate the field conditions before any conclusions are drawn.

Some rough tests were made on the effect of strain on water hammer strength and, as far as we were able to discern, annealing within ordinary commercial limits made little difference. Since the outer surface compression was always less than about 10 to 20 per cent of the total strength of the glass, we could hardly expect to find any startling differences. In general our results were completely masked by unknown variations in the surface strength.

The most important factor in the strength of a glass container has been pointed out by several authors to be the checks and flaws in the surface of the glass. In our studies of the field breakage due to water hammer we have found that about 99 per cent of the breakage was partially due to the presence of these surface checks. Since these flaws can vary the strength of glass by one or two orders of magnitude, it is obvious that they tend to be the controlling factors in the strength of a container. In water hammer breakage this effect is somewhat accentuated by the pick effect as compared to tests where large areas are under stress. When the pick action occurs on the sidewall opposite a check it has only to produce a stress of 3000 to 10,000 lbs./sq. in to cause fracture. It is apparent, therefore, that eliminating bad checks in the critical zones will produce a large increase in the resistance of the jar to water hammer breakage.

When surface checks are suspected of being a contributing cause to water hammer breakage, the ware should be etched in hydrofluoric acid until any checks are plainly visible. The great mass of ware so far studied, in which water hammer breakage had occurred, showed excessive surface damage in the sidewalls and sometimes in the base of the jar. Figures 43 to 49 show some of the various types of checks that have been found. Investigations conducted in one glass plant showed that the sidewall checks were made by the guide wires, the starwheel, and the push-bar stacker, and by touching other jars in the lehr. The checks on the bottom were usually caused by the conveyor belts. Some checks were caused by bad baffle marks due to poor molds. All these causes for checks can be stopped by careful attention to operating details, such as maintenance of proper temperature of metal parts contacting the hot glass, replacing asbestos protecting sleeves more frequently on vital metal parts, etc.

If the purchaser demands that the ware pass certain arbitrary tests before he will accept it, the glass manufacturer will probably find that the practical production method is to make well-distributed ware free from surface flaws. Then examinations for distribution and for surface flaws will be all the control tests needed. Since jars which are free from checks and bruises are five to ten times stronger, as far as the external strength is concerned, an ample margin of safety will be obtained.

To establish test limits, however, the glass packer must conduct a large series of field tests and then correlate these data with those obtained in laboratory tests. Moreover, since the degree of weakening done by checks may change very rapidly, tests should be made by the glass manufacturer approximately every half-hour.

It has been suggested that water hammer breakage may be prevented by packing the bottles or jars upside down. The reason for this is obvious, but we wish to point out that such procedure should be adopted only after considerable experimentation has been carried out on possible contamination or deterioration of the contents in contact with the metal, lacquer, rubber or other materials of the cap. In the case of catsups, where the closure is made of cork, apparently there is no difficulty, and we understand that this method of preventing breakage has been successfully used.

Another method is to design the carton and the container with water hammer breakage in mind. If the carton is high, compared to its width and breadth, it can be made so stiff that the jars cannot be moved appreciably when struck from the top and so a serious amount of water hammer cannot take place. Another type of carton might be made that would be so flexible that no matter how it was propped up, most of the bottles would be touching the ground. Of course, a carton such as this would be difficult to handle and might prove much more of an annoyance that it would be worth.

A type of carton which has shown excellent experimental results has a space of ½ to ¾ of an inch between the top of the jar and the top of the carton. If this carton is propped up on one side and stuck from the top, the separators will absorb the blow, and the jar and contents will float freely in space. Even if the top of the carton strikes the top of the jar, the blow will be greatly deadened. The disadvantages of this method are that the carton occupies 10 to 20 per cent more volume, and that being larger it will cost three or four cents more per

gross of glassware. However, some of the expense might be offset by lightweighting the ware.

The method of using special caps or necks might solve breakage problems in unusual containers. If the neck is choked down so that the liquid must flow slowly through to the headspace, the water hammer will be greatly damped, and it will simulate the effect of very little headspace. Special caps might also be made to produce the same results. As noted before, a light weight bottle often has a minimum water hammer strength when the head-space pressure is around 24 to 28 inches of vacuum. In such cases, considerable resistance to breakage may be obtained by radically increasing or decreasing the headspace pressure.

In some instances the packer could greatly reduce water hammer breakage by insisting upon more careful handling of the filled cartons. All places where water hammer breakage might occur should be studied carefully; the practice of propping up cartons on one side should be discarded. Trucks should be unloaded onto platforms to prevent the men from throwing cases down ten feet or so onto other cases. In general, the dropping of cartons more than a foot should be avoided. The ways in which carton breakage can take place should be carefully explained to the truck drivers and warehouse employees, and such measures as deemed necessary should be taken to have them handle the cartons carefully. One packing company has already had a great deal of success in reducing breakage by using this method.

Any of these several methods can be used to reduce water hammer breakage. Once it is established that water hammer breakage is taking place, cooperation between the glass manufacturer and packer will reduce or eliminate the difficulty by some combination of these methods. The only really good solution as far as the packer is concerned is one removing practically all danger of appreciable water hammer breakage; for if the situation remains on the ragged edge, a slight change for the worse in the manufacturer's ware, or a rush at the packing company with accompanying rougher handling, will cause a material increase in breakage. When the problem of water hammer breakage is understood by both the glass manufacturer and the packer, it is relatively easy to provide a wide margin of safety which will positively prevent appreciable breakage.

Acknowledgment

Data on water hammer breakage has been accumulated by several members of the staff of the Hartford-Empire Company under the direction of Mr. H. A. Wadman. The preliminary work was done by Mr. George Fleming, who first recognized the problems and contributed the field work, and by Mr. George Blessing, who discovered that dropping one case upon another produced this type of breakage. The photography was done by Messrs. Thomas D. Green, Roswell F. Hatch and G. Dudley Mylchreest. The testing machines were designed by Mr. Donald G. Merrill, and Mr. S. E. Robinson assisted with the testing.

The author is especially indebted to Dr. Bernard Vonnegut and Mr. Wadman for their discussions and advice leading to recognition of the real nature of the water hammer phenomena.

The author also wishes to express his appreciation for the helpful work of Professor Walter C. Schumb of The Massachusetts Institute of Technology, who tested the sample of glass for us on his cavitation apparatus.

[5]R. S. Vincent's "Cohesion of Liquids," Nature 6-22 970-971 (1940).
[6]loc. cit.

INVENTIONS AND INVENTORS

(*Continued from page* 528)

Glass Blocks

Patent 2,259,728 granted to Donald A. Bridges of Muncie, Ind. (Owens-Illinois Glass Co.), concerns apparatus for automatically performing many of the operations incident to uniting two halves to form a glass block. As shown in Figure 7 the halves are conveyed (15) open-side-up to the apparatus which has transferring arms 60 which pick up the individual halves, inverts them and dips their edges into a container of molten metal K which is the sealing medium. Other transferring arms remove them to a positioning or indexing table 20 where alternate halves are inverted and placed in accurate alignment on complementary halves to form the completed blocks by the usual pressing steps.

Otis W. Wiley of Port Allegheny, Pa. (Pittsburgh-Corning Corp., 2,261,011), has patented improvements in the type of glass block which contains a glass fiber screen for decorative and light screening effects. He provides two fiber-strand screens, crossing the block transversely of each other. Fiber strands of several colors may be used.

Glass Wool and Fiber

The latest Owens-Corning Fiberglass patent, 2,257,767, to Games Slayter and John H. Thomas, Newark, Ohio, gives a detailed account of steps, which are said to greatly improve the operation of fiber drawing apparatus, of the type which provides a number of metal feeders or bushings in the bottom of a fining tank. A principal improvement is the provision of means for electrically connecting the feeders in series and supplying electric current to heat all feeders identically. Burners may also be provided outside the furnace to be directed at the feeder apertures.

Miscellaneous Products

The preparation and use of glass products was covered by the following patents: 2,260,220 to Martin Grabau of Cambridge, Mass. (Polaroid Corp.), for a variable density window; 2,261,035 to Robert A. Miller of Tarentum, Pa. (Pittsburgh Plate Glass Co.), for a glass pressure relief diaphragm for relieving extraordinary pressures in fluid containers; 2,259,718 and 2,259,778 to Harold M. Alexander of Toledo and Erle T. Putnam of Detroit, respectively, for glass faced construction products (Libbey-Owens-Ford Glass Co.).

• Manufacturers of glass making machinery and printing presses and other printing machinery will be asked shortly by the Office of Price Administration not to advance prices above July 29, 1941 level, Administrator Henderson stated early in November. Meetings have already been held with manufacturers in each of these industries to discuss recent price trends and methods of achieving price stability in their respective fields.

AMORY HOUGHTON TO OPM

Amory Houghton, chairman of the board of directors of the Corning Glass Works, has taken an important position with the Office of Production Management, and will spend considerable of his time in Washington. Mr. Houghton will be in the Materials Division of the OPM in an administration capacity and is expected to begin his duties around the first of the year.

Mr. Houghton is another outstanding glass man to be drafted in the defense plans. John D. Biggers, president of Libbey-Owens Ford Glass Company, spent some 16 months as a top man in the OPM and then as a special minister to England, and William E. Levis, former president of the Owens-Illinois Glass Company, who is a member of the nine-man planning board of OPM.

• In the "Foreign Commerce Weekly" it was reported that the first flat-glass plant in Brazil may be erected soon. A recommendation by the Federal Council of Foreign Trade to render every possible assistance to such an enterprise has been approved by the President. The United States shipped 183,292 square feet of plate glass (includes standard and tempered or safety glass), valued at $54,832, to Brazil in 1940, and 39,664 square feet valued at $15,904 in the first three months of 1941.

• A meeting of the board of trustees, past-presidents and committeemen of the American Ceramic Society has been scheduled for Thursday and Friday, December 4 and 5, at Corning, New York.

Aplite

This new material for incorporating ALUMINA in glass at lower cost is providing excellent results.

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Pioneer Producer of APLITE
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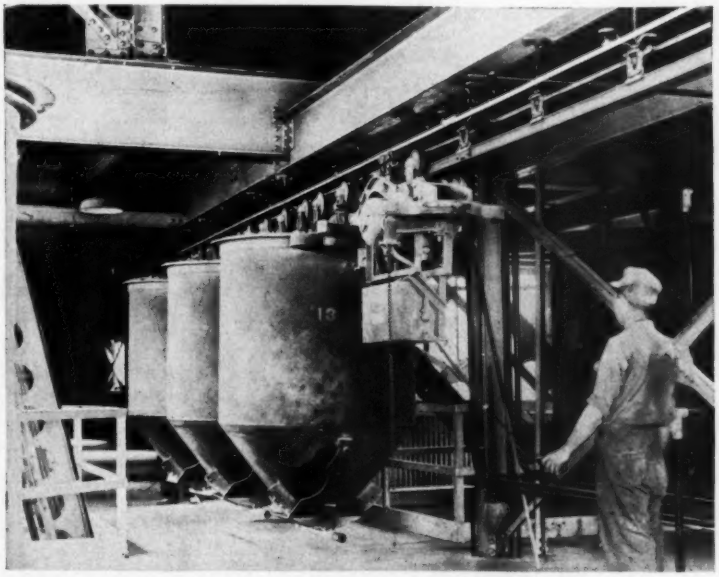

A 3-bucket train of batch en-route to doghouse. Electrically-driven bucket pusher is floor controlled.

More than 3,000 tons of batch materials is handled daily in various glass plants on Cleveland Tramrail equipment.

FOR UNIFORM GLASS 24 HOURS A DAY

The real reason why the quality of glass varies greatly in many plants is that the batch is not uniform.

Studies have proven that with usual batch-handling methods the analysis of batch varies between wide limits. This, of course, results in a more inferior product and considerable loss.

A Cleveland Tramrail batch-handling system makes it possible to get batch that is uniform 24 hours a day.

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. . . ours in the sense that we feel we can be of genuine service to you . . . ours in the sense that your problems are held in the strictest confidence, both by our organization and by our men who work with you.

Solvay Technical Service is composed of men who can give you more than mere opinions. You will find that their reports contain sound, well-thought-out solutions to your problems . . . solutions which could only be based on practical knowledge gained through years of specific experience in your field.

We would like you, as a glass manufacturer, to make the utmost use of Solvay Technical Service . . . to get the benefit of a competent, outside viewpoint on your glass manufacturing problems, especially as they relate to the use of alkalies. When problems arise, please do not hesitate to write us. Write to the nearest Solvay Office listed below.

60th ANNIVERSARY 1881 • 1941

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TECHNICAL SERVICE

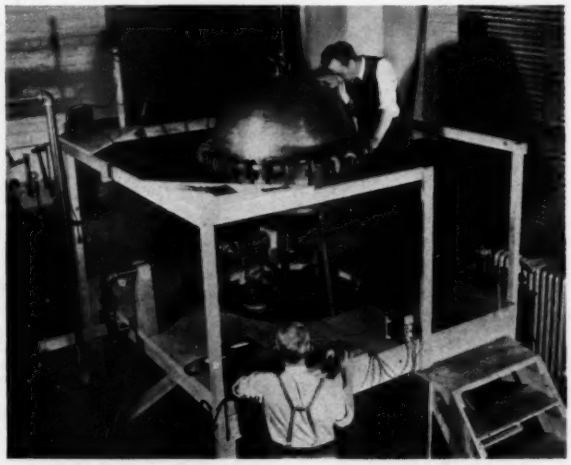
NEW DEVICE TRAINS EYES IN TEAMWORK

Optical setting-up exercises that do for the eyes what ordinary exercises do for the body are made possible by a new device shown for the first time to members of the American Academy of Opththalmology. The eyes are taken over an optical steeplechase which tests their co-ordination and their ability to judge distance or depth perception by means of a device called the ortho-fuser, which utilizes polaroid vectographs—three-dimensional pictures in the form of single prints—which are viewed through polaroid spectacles.

Differing from all previous processes of showing the third dimension, the vectograph process permits two complete and distinct pictures to occupy the same place at the same time, without distortion of tone, loss of detail, or interference with each other. In conventional photography pictures are rendered in terms of density of distribution of tiny silver particles, whereas in the new process pictures are rendered in terms of variation in the polarizing characteristics of the transparent sheets on which the pictures are printed.

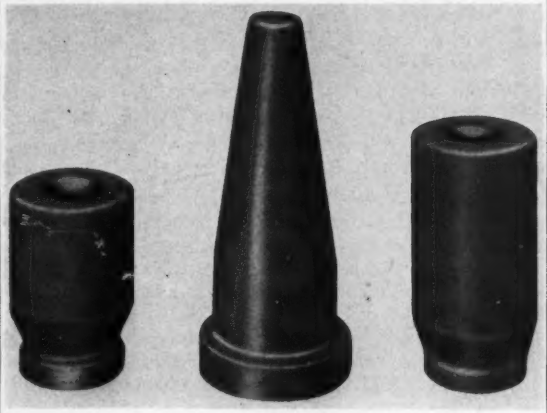
In order to secure the third-dimension in pictures, there must be two pictures, one for each eye. In the vectograph process the polarizing molecules in the surfaces of the relief films are oriented at right angles to each other, then one picture is superposed on the other. The polarizing axes of the viewing lenses are at right angles to each other, so that the right eye sees only the right-eye picture and the left eye sees the other.

The ortho-fusor, which is introduced by Bausch & Lomb Optical Co., and employs an invention of Edwin H. Land, is designed to restore precise and accurate stereoscopic vision to eyes which have lost some of their ability to fuse the two images seen by the eyes.



Annoying glare, reflected by light striking glass, is removed by a glass surfacing process carried out by a new apparatus developed under the direction of Dr. C. W. Hewlett of General Electric's research laboratory. The glass surfaces to be treated are placed in the large metal globe, shown above, as much air as possible is removed by a vacuum pump, then a small piece of magnesium fluoride is electrically evaporated, coating each surface with a film but 1/300,000th part of an inch thick. Glass to be treated is placed in metallic frames and then stuck to the inside of the globe by alnico magnets.

Gunite A-CCA For Moulds



GUNITE bottle moulds will reduce your production costs for GUNITE metal has the right hardness to facilitate easy machining and the right density to assure a metal which will take a brilliant polish. GUNITE has excellent thermo-conductivity, resistance to heat fatigue, freedom from foundry defects and an unusually long life.
Gunite Foundries has developed a metal for every type of glasshouse castings. Miller plungers and guide rings, neck ring sticks, bushing stock, press and blow moulds. Write us today

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GLASS INSPECTION
with the *Polaroid*

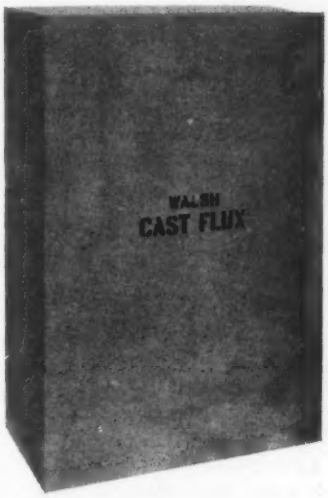
Spectacle type polariscope

THE polarizing spectacle, mounted in unit with sensitive tint plate of 565 millimicrons, presents an absolutely uniform field of large aperture, strains showing up in sharply defined and correct colors.

Standard size apertures are 6" diameter and 12" diameter; but any special size to meet your requirement can be made. They are all light in weight and a leather case can be furnished where required. The 6" unit is suggested for either plant inspection uses or—as a portable unit for the trouble shooter or the salesman where a large aperture, compact unit of light weight is desirable.

THE POLARIZING INSTRUMENT CO.
630 Fifth Ave. (Rockefeller Center) **New York City**

WALSH CAST-FLUX



The Vacuum-cast flux block of superior quality.

Walsh Cast-Flux blocks are machine-trued to exact size and shape after burning.

THEY LAST LONGER

The excellent results obtained in numerous tanks melting various types of glass has definitely established the efficiency and economy of Walsh Cast-Flux blocks.

Walsh Cast-Flux has a dense, uniform structure; it is burned at higher temperatures, is thoroughly bonded and possesses a low coefficient of expansion.

Walsh Cast-Flux blocks meet the most rigid requirements for tanks operating at higher temperatures . . . they insure greater tonnage, higher quality glass, freedom from defects, longer life and maximum economy.

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Defense Savings Pay-Roll Allotment Plan

How company heads can help their country, their employees, and themselves

voluntary pay-roll allotment plan | helps workers provide for the future | helps build future buying power | helps defend America today

This is no charity plea. It is a sound business proposition that vitally concerns the present and future welfare of your company, your employees, and yourself.

During the post-war period of readjustment, you may be faced with the unpleasant necessity of turning employees out into a confused and cheerless world. But you, as an employer, can do something *now* to help shape the destinies of your people. Scores of business heads have adopted the Voluntary Pay-roll Allotment Plan as a simple and easy way for every worker in the land to start a *systematic* and *continuous* Defense Bond savings program.

Many benefits . . . present and future. It is more than a sensible step toward reducing the ranks of the post-war needy. It will help spread financial participation in National Defense among all of America's wage earners.

The widespread use of this plan will materially retard inflation. It will "store" part of our pyramiding national income that would otherwise be spent as fast as it's earned, increasing the demand for our diminishing supply of consumer goods.

And don't overlook the immediate benefit . . . money for defense materials, quickly, continuously, *willingly*.

Let's do it the American way! America's talent for working out emergency problems, democratically, is being tested today. As always, we will work it out, without pressure or coercion . . . in that old American way; each businessman strengthening his *own* house; not waiting for his neighbor to do it. That custom has, throughout history, enabled America to get things done *of its own free will*.

In emergencies, America doesn't do things "hit-or-miss." We would get there *eventually* if we just left it to everybody's whim to buy Defense Bonds when they thought of it. But we're a nation of businessmen who understand that the way to get a thing done is to *systematize* the operation. That is why so many employers are getting back of this Voluntary Savings Plan.

Like most efficient systems, it is amazingly simple. All you have to do is offer your employees the convenience of having a fixed sum allotted, from each pay envelope, to the purchase of Defense Bonds. The employer holds these funds in a separate bank account, and delivers a Bond to the employee each time his allotments accumulate to a sufficient amount.

Each employee who chooses to start this savings plan decides for himself the denomination of the Bonds to be purchased and the amount to be allotted from his wages each pay day.

How big does a company have to be? From three employees on up. Size has nothing to do with it. It works equally well in stores, schools, publishing houses, factories, or banks. This whole idea of pay-roll allotment has been evolved by businessmen in cooperation with the Treasury Department. Each organization adopts its own simple, efficient application of the idea in accordance with the needs of its own set-up

No chore at all. The system is so simple that A. T. & T. uses exactly the same easy card system that is being used by hundreds of companies having fewer than 25 employees! It is simple enough to be handled by a check-mark on a card each pay day.

Plenty of help available. Although this is *your* plan when you put it into effect, the Treasury Department is ready and willing to give you all kinds of help. Local civilian committees in 48 States are set up to have experienced men work with you just as much as you want them to, and no more.

Truly, about all *you* have to do is to indicate your willingness to get your organization started. We will supply most of the necessary material, and no end of help.

The first step is to take a closer look. Sending in the coupon in no way obligates you to install the Plan. It will simply give you a chance to scrutinize the available material and see what other companies are already doing. It will bring you samples of literature explaining the benefits to employees and describing the various denominations of Defense Savings Bonds that can be purchased through the Plan.

Sending the coupon does nothing more than signify that you are anxious to do *something* to help keep your people off relief when defense production sloughs off; *something* to enable *all* wage earners to participate in financing Defense; *something* to provide tomorrow's buying power for your products; *something* to get money *right now* for guns and tanks and planes and ships.

France left it to "hit-or-miss" . . . and *missed*. *Now* is the time for *you* to act! Mail the coupon or write Treasury Department, Section A, 709 Twelfth St. NW., Washington, D. C.

FREE - NO OBLIGATION

Treasury Department, Section A,
709 Twelfth St. NW., Washington, D. C.

Please send me the free kit of material being used by companies that have installed the Voluntary Defense Savings Pay-Roll Allotment Plan.

Name _____

Position _____

Company _____

Address _____

THE TOLEDO TRIAL

(*Continued from page* 517)

Mr. Dorsey described in detail the numerous patent interference cases in which the Hartford concern had been involved through the years. He also gave a clear and concise picture of the patent difficulties with which the firm was confronted almost endlessly.

On cross-examination Samuel S. Isseks confronted Mr. Dorsey with numerous letters, memoranda, and other documents which had been written by Herbert Knox Smith, former secretary of the Hartford concern, and which have been received in evidence.

Upon these documents, and the loose use of strong words, which is the way defense attorneys explain them, depend much of the government's case. Mr. Dorsey said that while he never considered Mr. Smith inaccurate in his work nevertheless he (Mr. Smith) often reflected his own point of view to a degree which would not properly reflect the attitudes of the entire concern.

• According to a report in the Sourabaya "Handelsblad," a new glass industry will soon be established in Sourabaya. It will manufacture bottles and window glass which until now had to be imported. The enterprise is a joint Australian-N.E.I. firm. It will obtain its raw materials partly from Australia and partly from the Netherlands East Indies.

SHIPPING CONTAINER WEIGHTS

The Interstate Commerce Commission announced early in November its approval of what is probably the most effective way to save paper for shipping containers. By this action the carriers' regulations governing the acceptance of freight in solid fiber and corrugated board containers were so modified as to permit use of thinner board and consequent over-all saving of about 10 per cent of the tonnage. An OPM release said that the modification will release 250,000 to 300,000 tons of paperboard per year for defense, and "will enable the fibre box manufacturers to meet all present shipping container demands." The container division of OPM "believes that distribution costs of goods shipped in the new containers will be materially reduced."

Boxes to carry up to 40 pounds (combined weight of box and contents) now may be made with a minimum board thickness of .028 inch instead of the .041 inch formerly required. Not only is there a reduction in the thickness of the facings, but the combined thickness of the two facings is specified instead of the thickness of each facing. This will permit the use of any combination of thickness that will produce not less than the specified combined thickness. For example, 16-12, or 14-14 facings of any material may be used for the 40-lb. corrugated box provided it meets the specified minimum test strength which is unchanged from previous requirements. Corrugated boxes which will carry up to 20 pounds need have a total board thickness of only .018 inch, whereas formerly all boxes to hold less than 40 pounds had to have the .041 inch total thickness. The following table is from Supplement 17 to Consolidated Freight Classification No. 14, published Nov. 7. It applies to solid fiber and corrugated boxes:

(*Continued on page* 542)

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American Polishing Felts give superior service and have longer, satisfactory life. Polishing costs less and goes along without hitches when American Quality Felt is used, because it has uniform density and increased absorption properties. Greater strength against strains and stresses of mounting felt on the polishing head is another reason. Then, too, our Felt is put through a conditioning process which makes it ideal for beginning of the line and effects long life so that it performs satisfactorily at the important end of the line polishing. You are cordially invited to discuss any problem regarding polishing or the use of Felt with our Technical and Research Staffs.

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Max. wt. box and contents (pounds)	Max. inside dimensions added (inches)	Min. thickness solid fiberboard (inches)	Min. combined thickness of facings, inc. center liner double wall boxes (inches)	Min. test per sq. in. of combined board, solid or corrugated (pounds)
20	40	.045	.018	125
40	60	.055	.028	175
65	75	.070	.032	200
90	90	.090	.046	275
120	100	.100	.060	350

In some distances the dimensions of boxes are increased and there is a new provision reading: "If weight of any box and contents is less than any of the maximum weights shown in this section the maximum inside dimensions for that box may be increased the same per cent the actual weight is less than the maximum weight specified." To illustrate: a box for 10 lbs. weight is a reduction of 50 per cent from the specified 20 lbs. weight and therefore the dimension of the 10 lb. box may be increased 50 per cent or from 40 in. to 60 in.

The sealing provision for double-faced corrugated boxes will be as follows: "Boxes must be closed or sealed so as not to open during transportation. Paper sealing strips, if used, must be made of sulphate paper of basis weight not less than 60 lbs. per 480 sheets, 24 x 36 inches, testing not less than 60 lbs. and must be not less than 2 inches wide. If metal straps or wire are used, not less than 2 metal straps or wires must be used on each box and the center seam must be taped." This will permit the re-use of the boxes. (For empty bottles in carloads no kind of sealing is required).

Heretofore the requirements for inner packing of bottles appeared in Rule 41 and in Rule 5 of the Classification. They have now been eliminated from Rule 41 but are continued under Rule 5, which reads: "Articles which are easily broken, such as glassware or earthenware, or articles in glass or earthenware containers, must be adequately protected within the shipping containers against damage or breakage by liners, partitions, wrappers, excelsior or other packing material."

There are other less important changes but the Rule 41 requirements, effective December 20, 1941, are shown in their entirety in Supplement 17. It may be noted that the rule expires Nov. 15, 1942. If the present emergency continues and if the changes are practical, the requirements will no doubt be continued beyond that date.

• H. T. Florence has been named vice president of The Cleveland Crane & Engineering Co., Wickliffe, Ohio. This position is in addition to his present capacity of general manager. Mr. Florence has served with the company for 20 years in various shop departments, engineering and sales. W. C. Sayle who was formerly vice president has been elected president. He succeeds his father the late W. D. Sayle who founded the company in 1897.

• The Keystone Carbon Co., St. Marys, Pa., announces the opening of an Eastern sales office at 249 High St., Newark, N. J. Robert McKeown and Charles V. Allen are district representatives, succeeding the late E. A. Berger, sales engineer.

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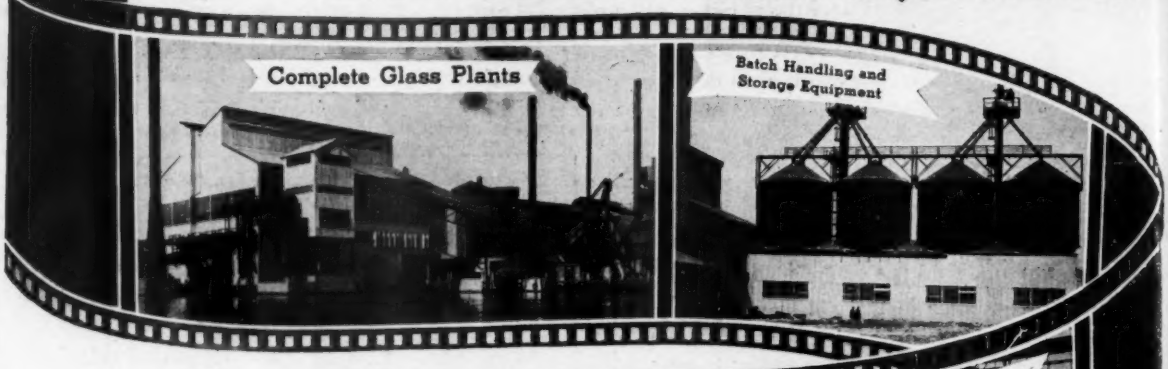

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Sheet and Plate Glass Lehrs

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Complete Window Glass Plants
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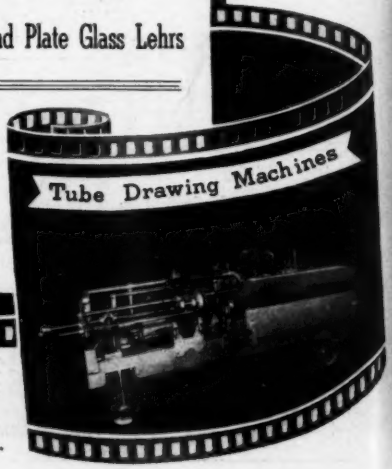
Appraisals



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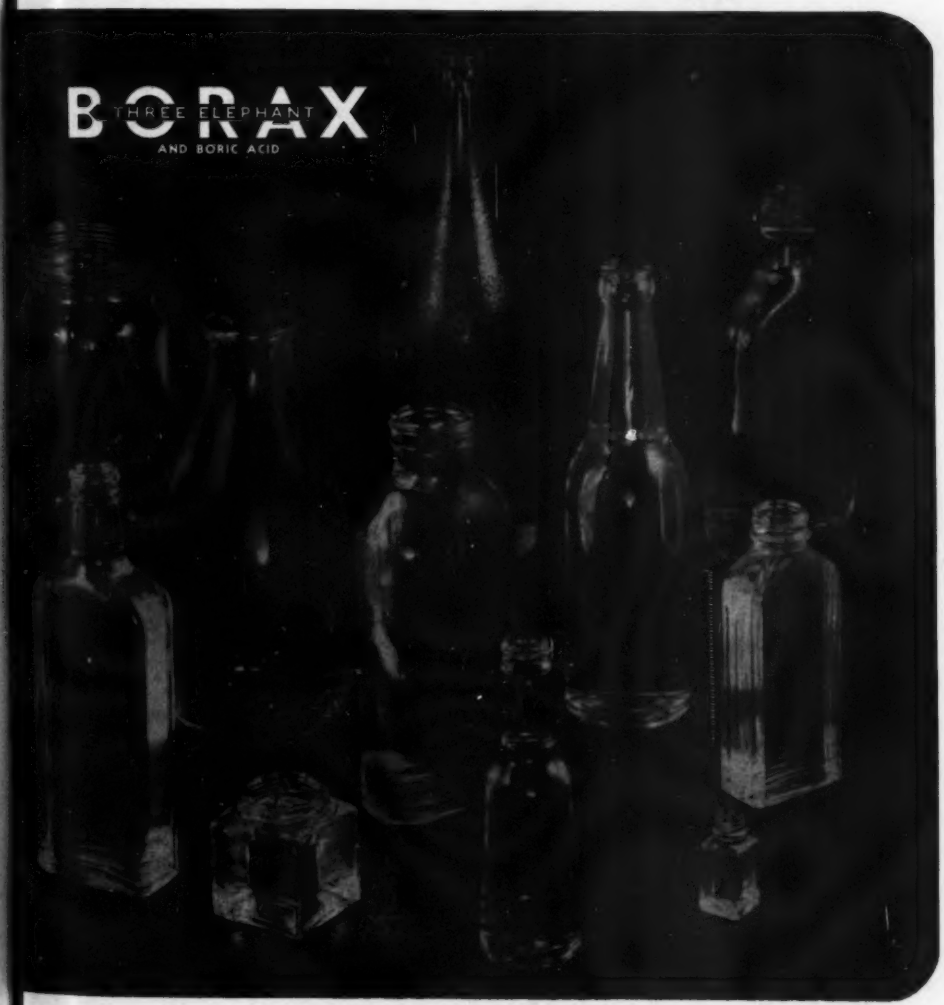

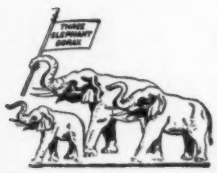

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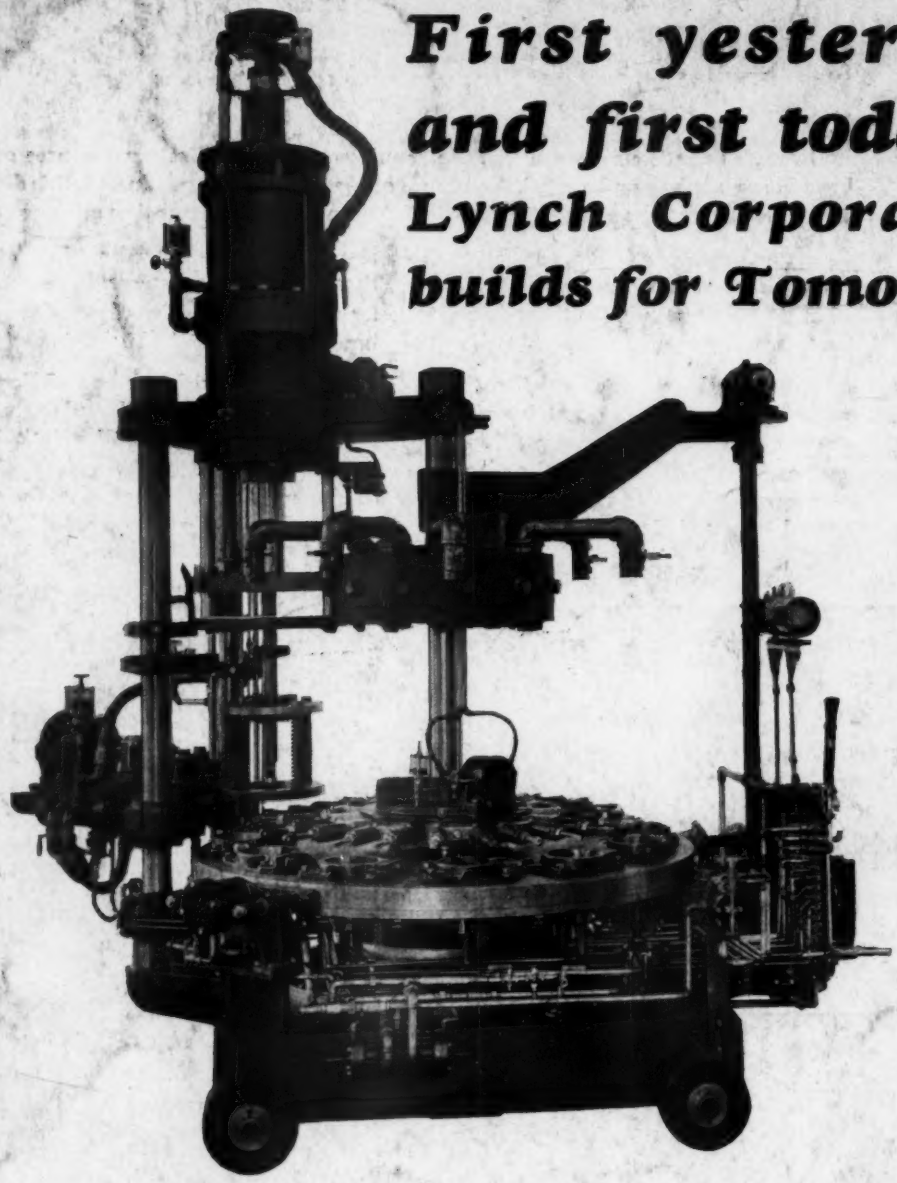

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